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THE MEASUREMENT OF NERVOUS HABITS IN NORMAL CHILDREN

UNIVERSITY OF MINNESOTA
THE INSTITUTE OF CHILD WELFARE
MONOGRAPH SERIES NO. III

THE MEASUREMENT OF NERVOUS HABITS IN NORMAL CHILDREN

By

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FOREWORD

The development of methods of measuring and recording the motor and emotional behavior of the individual, except in highly conventional laboratory situations, has lagged behind the development of methods for the measurement of intelligence, mental achievement, and other traits of an intellectual type. This has arisen in large part from a failure to develop a method in which one of the factors in the situation is kept constant. In this monograph Dr. Olson presents the results of an interesting investigation in the measurement of nervous habits or tics in children. He blocks out a method that can be described as a method of time sampling, the essence of which lies in the observation of the behavior of each individual in respect to the particular category of activity upon which information is to be obtained, during a period of time that is kept constant for each individual observed. The results of observations taken in this fashion can be evaluated in accordance with the statistical criteria evolved in other fields of measurement. When such an evaluation is undertaken, it is found that the technique is of considerable worth. In our earlier work, observations on one child for a short period of time were compared with observations made on another for a long period of time with the result that the data obtained were not comparable. In many respects the method developed by Dr. Olson furnishes one of the most interesting leads that has yet appeared for the future analysis of complex problems.

In this study a description is given of the method as applied to a particular problem. The relation of the occurrence of nervous habits to age, sex, and to a variety of other factors is traced through a group of children ranging in age from two to fifteen years. An interesting example of the technique applied to animals is also presented.

It is to be hoped that extensive attempts will be made to utilize the method developed on a wide range of problems. Sufficient use has been made of it on other problems in the Institute to demonstrate its promise.

JOHN E. ANDERSON,
Director, Institute of Child Welfare

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The writer wishes to thank the Director and staff of the Institute of Child Welfare and the officials of the Minneapolis Public Schools for the facilities necessary for securing the data for the study. He is further indebted to the Institute of Child Welfare for making possible the publication of this report.

WILLARD C. OLSON.

UNIVERSITY OF MINNESOTA
JULY, 1929

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CHAPTER I

INTRODUCTION

There appears to be at present a wave of popular interest in the scientific study of children. This interest is attested by the establishment of numerous child guidance clinics throughout the country, by the increasing influence of the juvenile court, by research on the preschool child in institutes of child welfare, by movements for parental education, and by an increasing number of individuals devoting themselves to the problems of child development with the resultant increase in the literature devoted to such studies. An examination of this literature reveals a growing emphasis on traits of character and personality.

Evidence that points to the importance of the individual's early life in the formation of habits that may make or mar his future life is accumulating daily. Such evidence suggests the possibility of prevention and control through the application of knowledge gained from a genetic approach to the problems of personality, delinquency, and nervous disorders. There is a feeling on the part of some that studies of this kind concern only the particular individual—the individual who is different, unusual, odd, or so marked by physical, mental, social, or emotional characteristics as to set him apart from the common group of children. Such evidence as is available on the distribution of conduct disorders, on emotional stability, on honesty, and on nervous habits indicates that these problems are the problems of every child, just as are matters of height, weight, intelligence, and educational achievement. These facts stand forth whether the study is made by rating-scale methods, by test methods, or by direct observation of child behavior. Research in this field, then, is not limited in its application to the extreme deviate whose failures are so pronounced as to make them easily observable. Clinical methods have made important contributions to the practice and knowledge in this field. There is need, however, that clinical studies be supplemented by a quantitative and experimental attack on many of the problems that arise.

The present report is concerned with an attempt to study the normal child with respect to certain characteristics which, in extreme forms, are considered abnormal. Preventive programs must rest in part on an accurate knowledge of what constitutes normal behavior. This is particularly true when the early recognition of deviations is an essential element in their amelioration. Determination of norms necessitates studying the generality of the population and avoiding the dangers of selection encountered in the usual clinical situation. The study has three general objectives: (1) the development of criteria of nervous habits in normal children; (2) the determination of the genesis and incidence of nervous habits in children; and (3) the development of differential tests and measures.

The method of securing the data for the criteria represents a natural history approach to the problem of measurement—the systematic observation of children in the school environment. In using this method the range of observation has been restricted and the data collected in such a manner as to yield results of determinable reliability. In the study of differential tests, use has been made of available psychological instruments and methods with modifications and developments introduced as needed. Certain data were obtained for the determination of relationships of nervous habits in children to other characteristics such as age, grade, sex, intelligence, fatigue, nutritional status, imitation, and family history. The data have been subjected to evaluation by statistical methods.

The intensive study of preschool children was made in the Institute of Child Welfare at the University of Minnesota. Thirty-six subjects were available, as well as several types of records made by specialists in various departments of the University. Data on approximately seven hundred school children were obtained through the cooperation of the Minneapolis public schools. A small group of adults at the University of Minnesota was studied for comparative purposes.

The method developed for the measurement of nervous habits has its background and justification in part in the clinical literature. This literature will, therefore, be considered in the chapter that follows.

CHAPTER II

TICS AS A BASIS FOR THE DEVELOPMENT OF CRITERIA OF NERVOUS HABITS IN CHILDREN

One of the most troublesome and difficult tasks confronting the psychologist who wishes to develop measures of any sort is that of securing a satisfactory criterion for determining the validity of his techniques. In the present chapter attention is directed to certain characteristics of human behavior that would seem to give a justifiable basis for criteria of nervous habits in children. The manifestation of tic is such as to lend itself readily to objective observation and the clinical literature would indicate that such observations should have considerable validity for the measurement of nervous habits in children.

Twenty-five treatises dealing wholly or in part with nervous and mental diseases were examined. Of these, fifteen were found to devote some space to a discussion of tics. A record was made for the tics specifically mentioned in each. Extracts were copied out wherever statements were made concerning definition or etiological factors. References to treatment are omitted as being beyond the province of the present study. The material obtained was grouped as follows for the purposes of this report:

1. Definition.
2. Etiology.
3. Inventory of tics.

The question of definition will be considered first to indicate what determined the final selection of items to be included in the inventory.

DEFINITION

All writers do not agree as to terminology in designating the disorders that are the subject of this chapter. The most common confusion is with regard to the use of the terms,

habit spasm and *tic*. It is obvious in the following selected definitions that the terms are being used as though they have the same significance.

"By a habit spasm is meant the constant repetition of an action which was originally designed to produce some definite result, but which has become involuntary, habitual, and separated from its original meaning."[1]

"These tics are essentially constituted by little movements of the face, head, or limbs, which appear at random, without any relation either to the present circumstances or the consciousness of the patient."[2]

"In these habit spasms the children make a series of involuntary muscular movements which they seem to be quite unable to control. The movements are often like those which are made for some special purpose, but under the influence of the tic they are made quite purposelessly."[3]

Some writers attempt to distinguish between *true spasm* and *tic* by ascribing a physical cause to the former. The following is an illustration of this attempt at differentiation.

"A spasm is a reflex act, manifesting itself in a chronic convulsion of a single muscle or a group of muscles. It is the product of a change, an irritation in the muscles or nerves of the spinal or bulbar reflex arc. Tic, on the other hand, is a psychoneurosis. It is a voluntary contraction which has become a habit. . . . Tic is always associated with a mental process; there is always a psychological aspect to the affection, and it may be associated with other evidences, or may be the only evidence of an abnormal psychic state."[4]

[1]Hector Charles Cameron, *The Nervous Child*, p. 90.

[2]Pierre Janet, *The Major Symptoms of Hysteria*, p. 119.

[3]James J. Walsh and John A. Foote, *Safeguarding Children's Nerves*, p. 207.

[4]Herman H. Hoppe, in White and Jelliffee, *Nervous and Mental Diseases*, II, 177.

Janet would reserve the name tic for rather sudden little movements of short duration and use other terms when the same involuntary movements have a greater extent.[5] Scholz would include a wider variety of movements. "Auch das Nägelkauen gehört zu den Tics, vie der Arzt alle diese triebhaften Bewegungen und Handlungen bezeichnet."[6]

Since the chief purpose in the survey of this literature has been to secure a list of behavior items that will have validity for the measurement of nervous habits in children, any movement that any writer would designate as a tic has been included in the inventory. The interest here is in measurement and not in a differential diagnosis of the types of spasmodic disorders. The list thus includes "conditions varying all the way from the so-called functional to well-marked organic diseases."[7]

ETIOLOGY

Eleven of the fifteen texts treat of etiological factors in the genesis of tics. The writers are unanimous in agreeing that the presence of tic is in some degree indicative of a neuropathic predisposition. This agreement among texts has been noted by Ferenczi.

> Der Tic wird in den meisten psychiatrischen Lehrbüchern als "Degenerationssymptom," als ein—oft familiar auftretendes-Anzeichen der psychopathischen Konstitution beschrieben. Wir wissen, eine verhältnismässig wie grosse Zahl der Paranoiker und der Zchizophrenen auch an Tics leidet.[8]

The following statements are typical of the opinion concerning the importance of tics in nervous disorders:

[5]Pierre Janet, *op. cit.*, p. 120.

[6]L. Scholz, *Anomale Kinder*, p. 55.

[7]White and Jelliffee, *op. cit.*, II, 176.

[8]S. Ferenczi, "Psychoanalytische Betrachtungen über den Tic," *Internationale Zeitschrift für Aerztliche Psychoanalyse* (1921), 7:37.

"A certain degree of mental instability is a distinguishing feature of tic patients. They are not insane, but are neuropaths or psychopaths."[9]

"With refusal of food and refusal of sleep they [habit spasms] form the three common neuroses of early childhood."[10]

Most of the writers agree that the neuropathic condition indicated by tics may be either hereditary or acquired. Emotional disturbances, bad training in childhood, and trauma are mentioned as exciting causes.

Nine of the eleven writers who discuss the etiology of tics mention the rôle of habit in their formation. The following statement will suffice for purposes of illustration:

> The special form of tic develops usually as a result of an external irritation, or on the basis of some idea, or both combined. Thus as a result of a defect in accommodation or of a conjunctival irritation, the child blinks his eyelids; later on the habit is established, the cause is removed, but the blinking continues without reason or purpose.[11]

Strained muscles, tight neckbands, ill-fitting coats, coughing, facial neuralgia, cold sores, decayed or erupting teeth, adenoids, phimosis, adherent prepuce, intestinal parasites, etc., are mentioned by the various writers as possible sources of irritation that may lead to the development of specific types of tic. According to Walsh and Foote, "Almost any normal movement may, in nervous children, come to be repeated so frequently as to become a tic."[12]

Certain writers have ascribed a definitely sexual basis to certain habits such as thumb sucking and nail biting. Freud takes thumb sucking as a model of the infantile sexual manifestations and notes its relationship to masturbation. He

[9]Hoppe, in White and Jelliffee, *op. cit.*, II, 177.

[10]Cameron, *op. cit.*, p. 91.

[11]Hoppe, in White and Jelliffee, *op. cit.*, II, 178.

[12]Walsh and Foote, *op. cit.*, p. 209.

assumes that the retention of thumb sucking as a habit is found only in children in whom the erogenous significance of the lip-zone is constitutionally reenforced.[13]

Moll, on the other hand, considers that these sucking movements have nothing to do with the sexual life of the child.

> We may, indeed, assume . . . that such sucking movements occur with special frequency in children with a congenital morbid predisposition, and that to this extent therefore it is connected with masturbation. But in my opinion it is essential to regard the two movements as clearly independent in character. . . . If we regard nail-biting as a "tic" occurring chiefly in neuropaths, and if we assume that the neuropathic congenital predisposition is the basis of the premature awakening of sexuality, it may be supposed that to that extent there exists a relationship between the two phenomena, inasmuch as we may refer both manifestations to a common cause, the neuropathic predisposition.[14]

Certain other factors have been mentioned by various writers as being important in the etiology of tics. Conflicting statements appear as to the age of onset of these habits and the course of the habits in relation to age. Writers disagree as to the relationship to sex, with the majority assuming that the habits are more common in females. Tics are apparently aggravated by poor general health, poor nutrition, emotional display and nervous fatigue, and too much or too little exercise. It has been noted that tics may be due to imitation in the early stages and may become epidemic. A quantitative analysis of certain of these factors will be attempted in a later portion of this report.

The best information from the clinical literature supports the conclusion that the persistence of tics in a child is dependent on neurotic tendencies, inherited or acquired, and that the particular form of tic which a child manifests is dependent upon habit formation resulting from repetitions of responses to irritating stimuli. The manifestations of tic will vary with general bodily condition, nutritional status, fatigue,

[13]Sigmund Freud, *Three Contributions to the Sexual Theory*, pp. 40-43.

[14]Albert Moll, *The Sexual Life of the Child*, pp. 172-173.

exercise, age and sex. This array of material offers considerable promise for the use of tics in constructing criteria for the measurement of nervous habits in children.

In order to have at hand, as a basis for observation, a rather complete record of movements in this general category, a tabulation of all the tics encountered in the study of the literature has been made. The list comprises 55 items and is based on fifteen treatises. The items were arranged in the form of a check list as they were obtained and the record of each book noted. One book mentioned as many as 27 items in the list and one book as few as 3 items with all variations in between. There was evidence for common sources in many of the writings. There has been some condensation in the list as submitted and classified. Overlapping of categories still exists, however. The inventory does not lay any claim to completeness in view of the numerous variations and possibilities of combination that occur in the manifestation of tics. The next chapter will describe the preliminary use of selected items in the inventory for the quantitative study of nervous habits in normal children.

AN INVENTORY OF TICS BASED UPON THE LITERATURE

A. Face and Head

Twisting hair
Grimacing
Puckering forehead
Raising eyebrows
Blinking eyelids, winking
Wrinkling nose
Trembling nostrils
Twitching mouth
Displaying teeth
Biting lips and other parts
Extruding tongue
Protracting lower jaw
Fingering ear
Picking nose
Sucking thumb or fingers
Biting nails
Nodding, jerking, shaking head
Twisting neck, looking sideways
Head rolling
Head banging

B. Arms and Hands

Jerking hands
Jerking arms; swinging arms
Plucking fingers; writhing fingers
Clenching fists
Striking head or body
Scratching
Manipulating genitalia
(See also Section A, above)

C. Body and Lower Extremities

Shrugging shoulders
Shaking shoulders
Shaking foot, knee, or toe
Peculiarities of gait
Body rocking
Body writhing
Jumping

D. Respiratory and Alimentary

Hiccoughing
Coughing
Hysterical laughing
Grunting
Barking
Sobbing
Sighing
Yawning
Snuffing
Blowing through nostrils
Whistling inspiration
Exaggerated breathing
Belching
Sucking or smacking sounds
Vomiting, regurgitating
Swallowing
Spitting and salivation
Clearing throat

E. Miscellaneous

Repeating words, tunes, etc. (echolalia)
Repeating actions seen (echokinesis)
Uttering obscene words (copralalia)

REFERENCES UPON WHICH THE INVENTORY OF TICS IS BASED

Bleuler, Eugen (tr. A. A. Brill). *Textbook of Psychiatry.* New York: The Macmillan Co., 1924.

Bridges, James W. *An Outline of Abnormal Psychology.* Columbus, Ohio: R. G. Adams and Co., 1919.

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Janet, Pierre. *The Major Symptoms of Hysteria.* New York: The Macmillan Co., 1907.

MacCarthy, Francis Hamilton. *The Healthy Child from Two to Seven.* New York: The Macmillan Co., 1923.

Moll, Albert (tr. Eden Paul). *The Sexual Life of the Child.* New York: The Macmillan Co., 1924.

Myerson, A. *The Foundations of Personality.* Boston: Little, Brown and Co., 1926.

Sachs, B., and Hausman, Louis. *Nervous and Mental Disorders from Birth through Adolescence.* New York: Paul B. Hoeber Co., 1926.

Scholz, L. *Anomale Kinder.* Berlin: Verlag von S. Karger, 1912.

Starr, M. Allen. *Organic and Functional Nervous Disorders.* New York: Lea Brothers and Co., 1907.

Walsh, James J., and Foote, John A. *Safeguarding Children's Nerves.* Philadelphia: J. B. Lippincott Co., 1924.

White, William A., and Jelliffee, S. E. *Nervous and Mental Diseases.* Vol. II, New York: Lea and Ferbiger, 1913.

CHAPTER III

PRELIMINARY OBSERVATIONS OF NERVOUS HABITS

The survey of literature in the previous chapter reveals that various tics are considered to have some significance as indicators of an undesirable nervous condition. The clinical use of these symptoms consists generally in noting simply their presence or absence. For measurement purposes it is not sufficient to state that a child has a particular habit or habits—a statement of amount must also be made. It is at least certain that all persons do not have these habits in the same amount and that the significance of a particular habit with a particular child will depend on its frequency of occurrence and its fixity as a mode of behavior. In making quantitative studies on children it is further necessary that a standardized procedure be used to secure comparable data.

The purpose of the present chapter is to report a preliminary attempt to develop a technique for stating nervous symptoms in quantitative terms. The method of securing the data represents a natural history approach to the problem of measurement—the systematic observation of children in their school environment. In using this method the range of observation has been restricted and the data collected in such a manner as to yield results of determinable reliability.

ORAL HABITS IN PUBLIC SCHOOL CHILDREN

In order to perfect his techniques the writer made a group of preliminary observations on 558 children ranging from the kindergarten through the eighth grade in an elementary school of Minneapolis. The school is located in a middle-class residential and industrial district and the children in the school are slightly above the general average in intelligence as indicated by group intelligence tests. The children are, for the most part, of Scandinavian parentage or descent. The preliminary observations were made in the month of October.

The procedure in each room was to make a seating chart giving the location of each child. The observer then took a

position at the front and side of the room where he could observe the faces of all the children and at the same time not interfere with the work of the class. The following group of oral habits was chosen for preliminary observation: nail biting, thumb sucking, and finger sucking. It soon became apparent that it would be easy to determine the existence of *an* oral habit but difficult, if not impossible, in some cases, to decide which habit was being practiced at a particular moment. Transitions from one to the other were also frequent. It was decided that the most objective results could be obtained by making a record for each penetration of the mouth by thumb or finger. It was further observed that continuous and active use of the pencil under the teacher's direction inhibited the manifestation of these symptoms. In making his observations the writer avoided classes in formal penmanship, music, and drill in arithmetic. He also avoided observations while children were working at the blackboard because of the attendant difficulties. His actual observations were limited to children while in their own seats doing seat work, oral recitation, silent reading, arithmetic problems—in short, any school activity in which formal obedience was not required.

The writer devoted several days to practice in observing oral habits. Single ten-minute observations were made in each room from the kindergarten through the eighth grade. It was found that 29 per cent of the boys and 45 per cent of the girls would show these habits under the conditions given. These figures indicate that the oral habits are prevalent in school children and more prevalent in girls than in boys. The writer does not attach much significance to the absolute percentages, since they are based on single observations and later investigation has shown that the prevalence of the habit in some degree is far greater than the percentage figures given.

The next step was to develop a method for giving an objective, quantitative expression to the persistence of the habit in a particular child. It was observed that certain children kept their fingers or thumbs in the mouth almost continuously, others occasionally, and others not at all. The first thought was that a check mark might be made for each occurrence in each child during a stated period. The children who practiced the habit continuously would not be properly

differentiated by such a method. It would also tax the observer's ability as a recorder to use such a method for a classroom of forty children. It was decided to make the unit of measurement one or more oral habits manifested during a ten-minute period and to rely on successive ten-minute observations as the means of differentiating the children in a group according to the persistence of the habit. It seemed reasonable to suppose that a child who manifested such an oral habit in each of a given number of periods was more fixed in this mode of behavior than a child who gave no such evidence or only an occasional occurrence.

Fourteen observations were made upon each of two groups of first and second grade children. The observations were made on four different days and were scattered over a total period of eight days. The school program was not modified for purposes of observation. Certain observational conditions were avoided as mentioned earlier. Table I gives the distribution of children obtained by this technique. The total column for these groups reveals that in fourteen ten-minute observations, four children out of seventy-six gave no evidence of the habit. At the other extreme there are three children who manifested the habit thirteen times in fourteen observations. All degrees of manifestations appear between these limits.

ORAL HABITS IN PRESCHOOL CHILDREN

To further test out the possibilities of the method developed for the observation of oral habits in school children, the same technique was applied to the children in the Institute of Child Welfare at the University of Minnesota.

The children had been divided into two groups on the basis of age. At the time of the observations the age range of the younger group was from 26 to 40 months and that of the older group from 40 to 57 months, with medians at 36 months and 49 months, respectively. The median age of the total of the groups was 42 months.

Certain changes in the technique of observation were necessary. Each child had to be identified as an individual and not as a seat location since there were no fixed positions

TABLE I

ORAL SCORES IN THE FIRST AND SECOND GRADES AND IN PRESCHOOL CHILDREN IN THE INSTITUTE OF CHILD WELFARE

SCORE	1ST AND 2ND GRADES			INSTITUTE		
	Boys	Girls	Total	Boys	Girls	Total
14	0	0	0	1	0	1
13	2	1	3	1	3	4
12	0	4	4	2	2	4
11	0	2	2	1	2	3
10	1	3	4	1	0	1
9	1	0	1	1	2	3
8	3	3	6	0	1	1
7	5	5	10	1	0	1
6	4	8	12	1	0	1
5	4	9	13	1	2	3
4	2	2	4	2	2	4
3	5	1	6	0	0	0
2	3	1	4	2	1	3
1	1	2	3	1	1	2
0	3	1	4	1	1	2
N	34	42	76	16	17	33
Median	5.8	6.6	6.3	7.0	9.2	8.5

for the children in the nursery school. There was only one time during the day that the children remained fixed for a length of time sufficient to enable the observer to watch all the individuals in a group simultaneously. This was during a period of about fifteen minutes each morning during which time the children were seated about a table for a cup of orange juice and around the teacher immediately after to listen to stories and tell their news.

Fourteen ten-minute observations were made on each group from October 21 to November 15, 1926. The time of beginning observations on the younger group varied between 9:45 and 9:55 A.M. and those of the older group between 10:00 and 10:15 A.M., depending upon fluctuations in the nursery school schedule. Observations on absent children

were made up by additional observations of the entire group at the above periods or by individual ten-minute observations subsequent to the general observation period.

The distribution of records for the thirty-three children for whom complete records were obtained is given in Table I. The variation in oral habits manifested in fourteen observation periods is from 0 to 14. The median number of manifestations is again higher for the girls and confirms the results of the previous work. The median for the entire group is somewhat higher than in the first and second grade observations. This is probably due to the somewhat more complete record resulting from watching a smaller group of cases under optimum conditions. There seemed to be some qualitative differences in manifestations in the preschool as compared to the school group. The amount of thumb sucking as compared to nail biting was higher for the younger children.

MISCELLANEOUS NERVOUS HABITS

Before proceeding further with the investigation some decision was necessary concerning the habits that were to be investigated most extensively. It seemed desirable to get an idea of the relative frequency with which the various habits are manifested in children. After several days of preliminary observations, guided by the inventory of tics found in the literature, the writer made a condensed inventory for convenience in observation. This inventory was then used in observing children in the Institute of Child Welfare for fifteen minutes daily for four days.

A check mark was made opposite the name of each child under the appropriate category for each habit manifested in a fifteen-minute observation period. In four fifteen-minute periods the maximum number of entries for a particular habit would thus be four. The condensed inventory and the frequency of total manifestation of each group of habits is given in Table II.

It will be observed from the Institute data that there are wide differences in the frequency of occurrence of the movements in the various categories. The use of the inventory with a group of public school children changes the order

TABLE II

CONDENSED INVENTORY OF NERVOUS HABITS WITH THE RELATIVE FREQUENCY OF OCCURRENCE OF EACH CATEGORY

HABIT	FREQUENCY 1*	2**
1. Oral (sucking thumb, sucking fingers, biting nails, protruding tongue)	83	70
2. Nasal (picking nose, scratching nose, wrinkling nose)	40	46
3. Manual (picking fingers, writhing hands, clenching fists)	20	22
4. Hirsutal (pulling and twisting hair, scratching head)	20	50
5. Aural (pulling ear, picking ear)	18	13
6. Irritational (scratching body)	16	30
7. Ocular (rubbing eyes, blinking eyelids, winking)	14	20
8 Genital (manipulating genitalia, thigh rubbing)	10	10
9. Facial (grimacing, twitching muscles)	6	24

*1. Preschool children, Institute of Child Welfare, University of Minnesota (N=35). Four fifteen-minute observations of the combined categories.

**2. Second and third grade children (N = 106). Single ten-minute observations of each category.

of frequency somewhat. Single ten-minute observations were made for each category in each room. Some of the changes in frequency are due to differences in the conditions of observation. It was difficult, for example, to watch the hands of the school children so that the observed frequency in the manual category is less than the actual frequency. The small number of cases represented would also cause some fluctuation in certain of the categories. The order of frequency of selected items in the inventory has been established with greater accuracy in a later portion of the research.

An attempt was next made to secure data on several of the categories, which would not only show the presence of *a* habit but also the *amount* of the habit in each child. Ten successive ten-minute observations were made in one or more rooms for each of the oral, nasal, hirsutal, ocular, and aural categories. One credit was given for one or more of the habits observed per ten-minute period. The possible range of scores was thus from 0 to 10. The results (Table III) reveal that differentiation can be secured by this technique for these habits. In general, however, better differentiation is secured in a stated time by the observation of the more frequently occurring phenomena. The large number of zero scores in the observation of certain habits indicated a necessity for more extensive observation in order to secure differentiation.

TABLE III

CENTRAL TENDENCY AND VARIABILITY FOR MEASUREMENTS OF VARIOUS NERVOUS HABITS

(Based on Ten Ten-Minute Observations)

CATEGORY	BOYS			GIRLS			ALL		
	N	Md.	Q	N	Md.	Q	N	Md.	Q
Oral	29	5.9	1.6	34	7.8	1.6	63	6.8	1.6
Hirsutal	31	5.1	2.0	28	5.0	2.1	59	5.1	2.0
Nasal	65	4.0	1.4	62	4.5	1.5	127	4.2	1.5
Ocular	18	3.1	1.4	16	2.8	1.3	34	3.0	1.2
Aural	37	1.5	.9	33	.7	.4	70	1.0	.7
Caputal	29	32.5	10.8	29	34.6	10.1	58	34.0	10.3
Composite	54	2.9	1.0	52	3.4	1.2	106	3.2	1.1

As a further study in method, observations were made for ten ten-minute periods in which all movements of the hand to the head were recorded. The record for each child would thus contain a combination of oral, nasal, hirsutal, aural, and ocular habits. The general category was given the name, "caputal." No restriction was placed on the number of entries in each period. The results give a good differentiation and represent an economical use of the observational time.

As a means of differentiation within a grade the method would be satisfactory. It was felt that little assurance could be placed on the comparability of results by this method from grade to grade because it demands a very high degree of concentration and very rapid recording on the part of the examiner. Variations in observers would be more serious with this method than with the others described.

Another method investigated was to use one or more habits per ten-minute period as the unit, make a single observation of each category, and pool the results. The gross scores indicate a fair degree of differentiation, but the method was discarded on the basis of lack of reliability in the total score.

The preliminary use of an observational method for the measurement of nervous habits in children has been described in this chapter. It is apparent that the method has some discriminatory capacity. The objectivity and significance of the data and the most economical method of securing it needs further study. The decision to devote the intensive portion of the investigation to the study of oral habits was based on the data that is presented on reliability and validity in the next chapter.

CHAPTER IV

RELIABILITY, CONSTANCY, AND VALIDITY OF THE MEASUREMENTS OF NERVOUS HABITS

With what accuracy can observational measures be obtained and how constant are the manifestations of the recorded habits? It is apparent that the reliability of the records, as records, will be dependent upon the accuracy of the observer at the time of the observation. Such accuracy does not give any assurance that subsequent applications of the technique under dissimilar conditions will yield constant results. If nervous habits in a given individual are approximately constant, subsequent measure by a valid method should be fairly constant. If neurotic manifestations are highly variable, constancy cannot be expected in measurements over a period of time, however reliable the observations or however valid the method. An analogy from the field of physical measurement will clarify this concept. Highly reliable measures may be made of the diameter of a steel shaft. If the shaft is then subjected to wear and subsequent measurements taken, they may be made with equal reliability—the diameter of the shaft, however, will not be constant on the two sets of measurements. Data will now be presented bearing on the accuracy of the observations and the constancy of the measurements over a period of time.

RELIABILITY OF ORAL RECORDS

The most crucial check of the accuracy of one observer's record is to have a second observer make records for the same children at the same time without collaboration with the first. Such observations were made on oral habits for a group of thirty-five second grade children.[1] The details of the method

[1]The writer is indebted to Mr. Alvin C. Eurich, assistant professor, Department of Educational Psychology, University of Minnesota, for assistance in this experiment.

were explained to the second observer but he did not have previous practice in applying the technique. The two observers took stations at opposite sides of the room. The time for beginning and ending each observation period was indicated on the blackboard. Seven ten-minute observations were made by each observer. The coefficient of correlation between the measures obtained by the two observers for seven periods was .75. This would yield a reliability of about .86 for the fourteen measures. It is evident that a fairly reliable record may be made under the conditions of the method.

A second method of obtaining the reliability of the records is to correlate the odd and even records for a given observer in securing a score at a given time. Here, however, the element of constancy also enters in. If the series of observations are made in a brief space of time, as on a single morning, it may be assumed that the conditions are fairly constant. With this method identical observations are not being compared, however. Fourteen observations were made by the writer upon each of two groups of thirty-eight children. One group was in the first grade and the second group was a combined second and third grade. The fourteen observations were made on four different days with a total of eight days between the initial and final records. The correlations (Table IV) again indicate a high degree of constancy although not as high as in the case of the simultaneous obser-

TABLE IV

RELIABILITY OBTAINED FOR ORAL SCORES IN THE PRELIMINARY STUDY

(Ten-Minute Observations)

GROUP	N	*r* 7 OBS.	*r* (SP. BR.) * 14 OBS.
Preschool	31	.87	.93
1A	38	.67	.80
2B-2A**	35	.75	.86
2A-3B	38	.63	.77

*Spearman-Brown.

**Two observers.

vations. Fourteen ten-minute observations of the preschool group over a period of a month with but a single observation on any one day yield still more reliable results ($r = .93$). The greater reliability in these records is probably ascribable to the smaller number of children observed at a time and to the fact that the observations were made under constant conditions of time and activity.

It has been mentioned that some experimentation was conducted with ten ten-minute observations. The reliability of such observations is high but not as high as if a greater number are taken (Table V). Further investigation revealed that twenty five-minute observations were superior, and this method was finally utilized in the main body of the study.

TABLE V

RELIABILITY OF TEN TEN-MINUTE OBSERVATIONS OF ORAL HABITS

GRADE	N	r 5 OBS.	r (SP.BR.) 10 OBS.
2A-3B	36	.62	.76
6A	53	.53	.69

The unit of measurement with the revised technique was one oral habit manifested per five-minute period. The possible range of scores was thus from 0 to 20. Oral habits included thumb sucking, finger sucking, nail biting, and protruding tongue. The twenty observations were made consecutively during a single morning in each room. The reliabilities for this method were determined for ages eight, ten, and twelve in the elementary grades and for the combined departmental grades. The reliabilities for the twenty observations vary between .68 and .94, with .87 the most representative value for the elementary grades and .82 the most representative value for the departmental grades (Table VI). Sex and age differences in reliability seem negligible in the elementary grades. The reliability for the boys in the departmental grades is better than that for the girls. The probable error of an estimate based on ten observations is but 1.67 observations

TABLE VI

SUMMARY OF RELIABILITY COEFFICIENTS FOR ORAL SCORES WITH REVISED TECHNIQUES

	BOYS			GIRLS			TOTAL		
	N	10 Obs.	20 Obs.	N	10 Obs.	20 Obs.	N	10 Obs.	20 Obs.
C.A.8	28	.76	.87	35	.57	.72	.....	....	....
C.A.10	42	.79	.88	49	.72	.84	.....	....	....
C.A.12	43	.71	.83	43	.89	.94	.....	....	....
C.A.8-10-12							240	.76	.87
Department	83	.83	.91	86	.52	.68	169	.69	.82

in the elementary grades and 1.68 observations in the departmental grades. It appears from this portion of the investigation that records of oral habits may be made with considerable accuracy. Practically any stated degree of accuracy may be obtained by multiplying sufficiently the number of observations.

THE CONSTANCY OF THE MANIFESTATIONS OF ORAL HABITS

Oral records may be made with some accuracy at a given time, but the constancy of oral habits as determined by repeated measurements over a period of time will be affected by a number of factors. These factors may be classified into two groups as errors of measurement and variations in the habit observed. Changes in method of observation and chance errors will tend to lower a coefficient of correlation obtained between two sets of measurements. Variations in the habit observed are fundamentally of greater importance. If the habit observed is constant and highly specific, the correlation will be high. If the habit observed is a good index of general nervous predisposition and such predisposition is a constant, the correlation will be high. If the habit observed is a good index of general nervous predisposition and such predisposition is a variable, the correlation will be low. If the habit observed is a variable manifestation of an underlying constant predisposition, the correlation will be low. This would be the case where the nervous habit is but an epiphenomenon of

the underlying predisposition manifesting itself at one time in one form and at another time in another form. Finally, if the habits observed are but the variable expression of a variable predisposition, the correlation will be low. These possibilities have been cited to indicate the task confronting anyone in the interpretation of obtained results. The constant and variable errors of measurement lend themselves to objective analysis. The underlying factors involved in the genesis and manifestation of oral habits are more complex and their discussion must be in part left to a later portion of the study.

Dual measurements were obtained on seven groups of children. The dual measures in four groups were the incidental result of experimentation with method and in three groups the result of a planned attack on the problem. It will be recalled that the writer experimented with three methods of making observations, and finally made observations for the entire school by the third method. This resulted in dual measurements on certain children at intervals of from 8 to 158 days. In addition, two groups were measured with the revised technique at intervals of thirty-five and forty days. Observations of two grade groups one year after the completion of the collection of the data for the main study yielded repeated measurements on forty individuals. The highest correlation was .80 in a 6A group between ten ten-minute observations and twenty five-minute observations at an interval of eight days. The lowest correlation found was .26 in a second grade group between fourteen ten-minute observations and twenty five-minute observations at an interval of 158 days. The remaining coefficients (Table VII) are homogeneous at a value of about .50. The probable errors of estimate in terms of the second measures on the basis of the first vary between 1.9 and 3.1 five-minute periods. The smallest coefficient does not have the largest error of estimate, and would be increased in size by a correction for differences in variability. The coefficients of correlation have been corrected for the unreliability of the correlated measures in the last column of the table. In the corrections, .76 has been used for the reliability of ten ten-minute observations and .80 and .87 for the reliability of fourteen ten-minute observations and twenty

five-minute observations, respectively. The corrected values are appreciably higher and indicate that greater reliability of method such as might be secured from a greater number of observations will operate to produce greater constancy in the dual records.

TABLE VII

CONSTANCY OF ORAL HABITS OVER AN INTERVAL

GRADE	N	INT. DAYS	METHOD*	r	$S.D._2$	$P.E._{est}$	r (CORR.)
6A	25	8	1	.80	4.6	1.9	.98
5B	31	40	2	.50	5.0	2.9	.57
3A	31	35	2	.51	3.9	2.4	.59
2B-2A	29	49	1	.49	4.6	2.7	.60
2B-2A**	32	158	3	.26	3.6	2.3	.32
1A-2B**	26	150	3	.49	5.2	3.1	.59
3A-5A	40	365	2	.40	5.0	3.0	.46

*1. Ten ten-minute observations vs. twenty five-minute observations.
2. Twenty five-minute observations vs. twenty five-minute observations.
3. Fourteen ten-minute observations vs. twenty five-minute observations

**See discussion of constant errors in these results.

The corrected coefficients give some idea of the relationship that would obtain if the variable errors of measurement were eliminated. The coefficients for the 150 and 158 day intervals are too low, however, by reason of certain constant errors affecting one set of measurements and not the other. It will be recalled that the fourteen ten-minute observations were made in the initial experimentation with the method. In the initial experimentation thumb sucking, finger sucking, and nail biting were observed. In the final application of the method, protruding the tongue and licking the lips were also included. Certain children with these specific habits might thus get high scores on the second trial who had low scores on the first. A statistical analysis of the records substantiates this assumption. Of fifty-eight cases, sixteen are found to be in the second and fourth quadrants of the correlation array, i.e., they are discrepant cases. Of the sixteen discrep-

ant cases, eleven are found to be above the average on the second measurement but below the average on the first. Another constant factor is the skill of the observer, which might presumably be lower in the tentative experimentation with the method. No record was made except when the habit was actually observed. On the other hand, with an unskilled observer certain lesser manifestations may fail to be observed. On the second measurement these might be detected and would tend further to place cases in the second quadrant. This assumption is substantiated by the almost total disappearance of zero scores in the revised method compared to the greater frequency of such scores in the tentative method. A further factor is that the children measured with the fourteen ten-minute observations had changed rooms and teachers and were found scattered through several rooms on the second measurement. It will be seen later that the habits appear to be to a slight extent amenable to environmental influences operating over a few months, and that such influences will tend to lower coefficients over the longer intervals as compared to the briefer periods of time when children remain for the most part not only in the same room but in the same seats.

It is believed that the data presented on the constancy of manifestation of oral habits makes tenable two hypotheses: (1) that the habits are highly specific and fairly constant; or (2) that the habits are a good index of an underlying predisposition, which is a constant over the periods of time studied. Support of the second hypothesis as against the first must come from a presentation of facts concerning the degree of generality as measures of nervous habits, which may be assumed from our oral scores. This question will be considered later under the heading of "Validity."

RELIABILITY OF SELECTED MEASURES OF NERVOUS HABITS

In previous sections the reliability with which measures of oral habits may be obtained has been given. During the experimentation with method a variety of observations on other habit categories were made. The reliability of these measures is of interest for the general problem. In the discussion that follows it should be remembered that all of the

reliabilities may be increased by increasing the amount of time spent. The reliabilities may also be increased by improving the method of observation as was done with the oral records. Comparisons of reliabilities can only be made properly when time is a constant. In the case of the infrequent manifestations the number of *effective* observations in a given time is less than in the case of the more frequent. An increase of effective observations by an increase of time would improve the reliability. Differences in some instances may be due to actual differences in the constancy of manifestation of the habits and the ease and objectivity with which they may be observed.

Reliability has been stated in terms of the coefficient of correlation. For some purposes a statement in terms of the error of prediction would be superior, as it would take into account the differences in variability, which are dependent, somewhat, on the frequency of manifestation. On the other hand, such differences in variability are an intrinsic part of the method where constant time is maintained.

The reliabilities of the observations of nasal, hirsutal, ocular, aural, composite, and caputal records are lower than those obtained with the revised oral techniques (Table VIII).

TABLE VIII

RELIABILITIES OF CERTAIN OBSERVATIONAL MEASURES

HABIT CATEGORY	GRADE	N	*r* 5 OBS.	*r* (SP. BR.) 10 OBS.
Nasal	1B	33	.13	.23
Nasal	2B-2A	34	.39	.56
Nasal	2A-3B	35	.24	.39
Nasal	6A	25	.43	.60
Hirsutal	2A-3B	35	.68	.81
Hirsutal	6A	23	.46	.63
Ocular	2A-3B	34	.53	.69
Aural	2A-3B	34	.36	.53
Composite	2A-3B	34	.30*	.46*
Caputal	2A-3B	35	.72	.83
Caputal	6A	24	.63	.77

*Ten and 20 observations, respectively, instead of 5 and 10.

The reliabilities of the hirsutal, ocular, and caputal measures, however, compare favorably with a similar method (ten ten-minute observations) of securing oral scores.

It seems reasonable to suppose that the most valid and reliable measure of nervous habits would be represented by differential measures on each of the categories with subsequent summing into a total. Such a method would require a large expenditure of labor and would make studies of large groups a prohibitive undertaking. Is it possible to secure a useful measure of the whole by measuring a single category? Such a possibility is dependent upon the presence of a relationship between the various categories. The evidence for such a procedure will be presented in the next section.

VALIDITY OF MEASURES

The general problem of test validation is a most difficult one and is, in general, less amenable to crucial proof than most problems with which we deal. Because of the difficulty of determining exactly what a test measures, many tests in the field of personality have been reported that confine their statistical study to distributions of scores and determinations of the reliability of such scores. The name of the test and the thing measured has been often determined simply by the manifest content or the intention of the author. There is a growing cautiousness, however, in the degree of generality that is claimed for most tests, and growing evidence that the manifest content of paper-and-pencil tests may be somewhat at variance with the function actually measured.

In the present problem it appears that there are three degrees of validity which may be proposed for the measures. In the first place, it may be assumed that the measures are representative and valid measures of the content that determines them. Thus oral scores may be assumed to be valid measures of oral habits because one oral habit per five-minute period is the unit of measurement. In the second place, it may be demonstrated that the single measures have some validity as measures of nervous habits in general. Justification for this more general validity must come from the intercorrelations that exist among the various groups of habits.

Finally, it may be contended that the techniques measure neurotic tendencies in general. This assumption is on less safe ground and represents a position that is less susceptible to statistical demonstration.

In the present discussion, the degree of validity implied in the first assumption will be taken for granted, the degree of validity in the second will be demonstrated, and the support for the third will be left to the evidence cited in the clinical literature and to the data presented under etiological factors and test techniques. The writer does not mean to imply that the third degree of generalization for the measures could not be proved or disproved in a crucial manner. The comparison of a group of diagnosed neurotics and non-neurotics would throw light on this problem. The difficulty of obtaining such groups under comparable conditions would make such a demonstration a major research project in itself and has appeared impracticable in the present study.

What is the evidence concerning the interrelations among nervous habits? Data were secured on a combined second and third grade group with a variety of techniques, which have been described elsewhere. The intercorrelations among the more frequently occurring groups of habits are presented in Table IX. The raw coefficients are lower than the true

TABLE IX

INTERCORRELATIONS BETWEEN VARIOUS MEASURES OF NERVOUS HABITS*

(Grade 2A-3B; N = 30)

	ORAL	NASAL	HIRSUTAL	OCULAR	CAPUTAL
Oral	.76	.48	.25	.04	.70
Nasal	.88	.39	.48	.37	.48
Hirsutal	.32	.85	.81	.40	.37
Ocular	.06	.71	.54	.69	.54
Caputal	.88	.84	.45	.71	.83

*The coefficients above the line are the uncorrected values. The coefficients below the line are the values for the coefficients corrected according to the self-correlations within the heavy lines.

amount of relationship obtaining because of the unreliability of the correlated measures. The values corrected for attenuation have accordingly been included in the table. In general, it may be said that a positive and significant relationship exists between the various categories. The uncorrected values vary between .04 and .70, and the corrected values between .08 and .88. The highest intercorrelations are with the caputal category, since this is a category that involves all of the habits in the remaining categories.

TABLE X

CORRELATION OF EACH MEASURE OF NERVOUS HABITS WITH THE TOTAL OF THE REMAINING MEASURES

(Grade 2A-3B; N = 30)

HABIT	MEAN 10 OBS.	S.D. DIS.	*r* WITH REMAINING MEASURES
Oral	7.1	2.5	.77
Nasal	5.0	2.0	.69
Hirsutal	5.6	3.0	.42
Ocular	2.9	1.6	.32
Aural	1.6	1.6	.27
Composite A	3.6	1.3	.44
Composite B	3.2	1.5	.10

A better type of evidence is offered in the correlations existing between each of the methods and the total of the remaining methods. Each measure is thus being correlated with a criterion of more general significance than obtains with single categories. The correlations of each of the seven measures with the total of the remaining six are presented in Table X. The coefficients vary between .10 and .77. This analysis points to the oral category as being most predictive of the total. It will be noted that the size of the reliability coefficient is related to the number of effective observations, as indicated by the mean of the distribution, and somewhat related to the variability of the measures as indicated by the standard deviation. No attempt has been made to correct the

coefficients for differences in the variability of the measures, as they are an intrinsic part of the method where constant total time of observation is maintained. The composite measures cannot be compared directly to the others because of differences in method. The caputal category with the total of the seven given in Table X yields a coefficient of .36—somewhat smaller than would be expected from the intercorrelations obtained in Table IX. All of the correlations would be increased by perfected methods of observation and greater length of time.

SUMMARY

The results in the present chapter reveal that oral habits with the revised techniques may be measured with a reliability indicated by a coefficient of correlation of about .85, and that such measures will have some constancy over periods of time varying from 8 to 365 days.

The measurements of oral habits have a validity in terms of a total of nervous habits indicated by a coefficient of .77. The interrelationships among the various categories are all positive.

As a result of the findings in the present chapter, oral habits have been used as the basis for the more extensive study of nervous habits presented in succeeding chapters. This has been done with the realization that a more valid measure could be secured by combining with oral records similar observations on other groups of habits. It would be impossible, however, to do this and keep the study within reasonable time limits. Some additional data will be presented, however, on the frequency of occurrence of various categories. The next chapter will be devoted to an analysis of the distribution and incidence of nervous habits in children.

CHAPTER V

THE DISTRIBUTION AND INCIDENCE OF NERVOUS HABITS IN CHILDREN

After the results given in preceding chapters were at hand, the writer felt justified in collecting data systematically on large numbers of children. The purpose of the present chapter is to present the results of extended observations and to determine the incidence of nervous habits with respect to age and sex. The method and conditions of observation of oral habits will first be presented for the guidance of those who may be interested in similar studies.

MATERIALS

The observer was provided with a seating chart of each room with the name of the child in each seat and squared spaces for making twenty entries below the name. Space was provided on the chart for identifying data such as grade, room number, teacher, and date, and for the time of beginning and ending each of twenty observations. An ordinary watch with a minute hand was used for recording time. A board with a clamp served for a writing surface.

METHOD

The observer took a position at the front and left (pupils' left) of the room. If the room has the proper natural lighting this position will avoid or minimize the glare of light in the observer's eyes. The unit of measure was one or more oral habits per five-minute period. Oral habits as used in the revised study included thumb sucking, finger sucking, nail biting, and protruding tongue. This means that any penetration of the lips by thumb or finger constituted a manifestation as did any extrusion of the tongue. Putting the pencil in the mouth was not counted unless accompanied by thumb or finger. Although the pencil may be a substitute for the thumb or finger in many cases and pencil biting may be

considered in part a nervous phenomenon, the inclusion of such observations would introduce an adventitious circumstance. But one entry was made per child per five-minute period, regardless of the frequency within the period, so that with twenty observations the possible range of scores was from 0 to 20. Each manifestation was recorded under the appropriate name on the chart and in the square with a number corresponding to the number of the observation. The time of beginning and ending each observation was recorded.

VARIATIONS IN METHOD

Observations of other habits were made and recorded as outlined above. In the observation of genital habits it was advantageous to take a position at the left middle of the room; in the observation of aural habits the rear middle was superior. In the observation of kindergarten children a number was pinned on each child and a chart with an appropriate key constructed. In the observation of the preschool children the numbers were unnecessary, since the observer was acquainted with the children by name.

TIME OF OBSERVATION

In the present research all oral observations with the revised technique in the elementary grades were made in the morning at the rate of one room per morning. Observations commenced with the opening of school (9:00 A.M.) and continued for twenty five-minute periods. The observations were made consecutively except when recess or unfavorable observational conditions as defined later intervened. It is probable that data collected in the afternoon are not absolutely comparable in terms of amount to data collected in the morning, although the relative differentiation of the pupils remains the same. The single five-minute observations of oral, nasal, hirsutal, ocular, aural, and genital categories were made consecutively in the order named beginning with the opening of school in the afternoon of the same day as the twenty oral observations. An exception occurred in the two first grade rooms, which were on half-day sessions.

In the departmental grades it was necessary to confine all observations to the first hour in the morning in each room. To secure twenty observations it was necessary to observe two first hour periods. Undesirable observational conditions could not be avoided as in the elementary grades.

The observations in the present chapter were made during the month of April. It is not known to what extent seasonal variations may affect the results. Pediatricians report an apparent increase in allied disorders in the spring months.

UNDESIRABLE OBSERVATIONAL CONDITIONS

Continuous and active use of the pencil or hands under the teacher's direction inhibits the manifestation of the symptoms observed. Classes in formal penmanship, music, and drill in arithmetic were avoided, as were observations during periods when children were out of their own seats.

THE OBSERVER

Differences due to the observer have not been investigated in detail. It is probable that practice increases somewhat the accuracy of a given observer. The present data were collected after an experimental period involving not less than twelve hours of actual observation time. It is probable that a few practice periods should be spent before attempting to collect data for any serious purpose. The task itself is simple—the important thing is objectivity and accuracy on the part of the observer. The conditions have been simplified to reduce the variability of the observer to a minimum.

With the method and under the conditions outlined above the following data were collected.

DISTRIBUTION OF ORAL HABITS IN CHILDREN

Records were made for 467 children in grades one through six, and on 169 children in grades seven and eight. These numbers represent the entire population of an elementary school of Minneapolis with the exception of those individuals who were absent on the day of observation. The range of scores is from 0 to 20 with continuous variation be-

TABLE XI

DISTRIBUTION OF ORAL SCORES BY SEX FOR ELEMENTARY AND DEPARTMENTAL GRADES

	ELEMENTARY			DEPARTMENTAL		
Scores	Boys	Girls	All	Boys	Girls	All
20	2	....	2	....	....	....
19	1	7	8	2	....	2
18	3	10	13	2	2	4
17	3	14	17	4	0	4
16	9	21	30	1	2	3
15	16	15	31	3	6	9
14	13	14	27	1	3	4
13	13	10	23	1	5	6
12	14	29	43	6	7	13
11	14	17	31	3	6	9
10	15	12	27	5	6	11
9	15	21	36	4	12	16
8	13	18	31	2	5	7
7	18	16	34	7	5	12
6	17	14	31	9	4	13
5	11	9	20	9	5	14
4	16	8	24	4	5	9
3	12	6	18	8	7	15
2	10	1	11	5	3	8
1	9	....	9	5	2	7
0	1	....	1	2	1	3
N	225	242	467	83	86	169
Md.	9.3	12.0	10.7	6.9	9.5	8.5
M	9.5	11.7	10.7	8.2	9.3	8.8
$S.D._{dis}$	4.67	4.30	4.63	5.05	4.31	4.72
$S.D._{M}$	.31	.27	.21	.55	.46	.36

tween (Table XI). The mean score of grades one through six is 10.7 and the mean of the departmental grades is 8.8. The means and medians agree very closely for all distributions except for the departmental boys where there is some evidence of positive skewness. The measures of variability are

homogeneous. These data, as well as those presented earlier in the study, indicate that nervous habits are distributed among children in the form of a continuous distribution. Properly stated the question concerning a child is not, "Is he nervous?", but, "How nervous is he?"

There is a difference of 1.9 in the mean manifestation in the first six grades and in the departmental grades. This difference is about 7.8 times the probable error of the difference, which indicates that it is not a chance fluctuation due to sampling. An analysis presented later reveals that this difference is not ascribable to age differences, because it is maintained when children of the same age in the two groups are compared. It will be recalled that the departmental grades were observed under different conditions than the elementary grades and this factor seems the most probable explanation of the difference. It is suggested that in careful work where children are observed under dissimilar conditions and it is necessary to make subsequent composites of the results it would be advisable to transform scores into units of the standard deviation. Each child thus receives a score that represents his deviation from the mean of the group and eliminates constant errors affecting the mean. Some such transformation scheme is especially essential when children are observed under conditions that maintain in preschools and kindergartens. The activities in which kindergarten children engage inhibit many of the movements, and successive observations during the course of a morning will result in a lower mean.[1] If optimum conditions are chosen in these early ages, higher means will result, as illustrated elsewhere with preschool children. Under the usual classroom conditions, observations taken in each room during the morning will be comparable.

RELATIVE FREQUENCY OF VARIOUS HABITS

Single five-minute observations were made in each room for the first grades for oral, nasal, hirsutal, ocular, aural,

[1]An analysis of 100 observations in the kindergarten reveals that the manifestations will be 48 per cent of the possible total when the children are seated and but 21 per cent of the possible total when they are at free play.

and genital habits. This was done to establish more reliably the relative frequency of these habits and to furnish data for group comparisons. While the absolute values have little significance and single observations are unreliable, the massing of such observations on large numbers of children offers a basis for group comparisons. The data obtained (Table XII) indicate the same order for the frequency of these habits as was found in the preliminary study of school children.

TABLE XII

RELATIVE FREQUENCY OF NERVOUS HABITS

(N = 459)

CATEGORY	FREQUENCY
Oral	247
Nasal	127
Hirsutal	105
Ocular	69
Aural	48
Genital	17

SEX DIFFERENCES IN NERVOUS HABITS

The girls in the first six grades average 2.2 higher in oral habits than the boys. The difference is 1.1 in the departmental grades, and is in the same direction. These differences are respectively, 7.9 and 2.3 times the probable error of the difference and represent a probable significance of 1,470,588,234 to 1 and 7.3 to 1. A later analysis indicates that the sex differences are maintained at practically all ages (Table XIV, Figure 1).

An analysis of the data on the various nervous habits reveals that the girls exceed the boys in oral, hirsutal, and ocular habits, and that the probability of such differences being significant is high in all cases (Table XIII). The boys exceed the girls in nasal, aural, and genital habits, but the probability of the significance of such differences is low. The summary figures indicate a high probability that girls have more nervous habits than boys—the chances being 142 to 1.

TABLE XIII

SEX DIFFERENCES IN NERVOUS HABITS

(Boys, N = 221; Girls, N = 238)

Habit	Boys			Girls			D in Per Cent	$P.E._D$	$D \div P.E._D$	Probability
	N	Per Cent	P.E. Per cent	N	Per Cent	P.E. Per Cent				
Oral	104	47	2.3	143	60	2.2	13	3.2	4.1	175 to 1
Nasal	62	28	2.0	65	27	2.0	–1	2.8	–.4	.4 to 1
Hirsutal	38	17	1.7	67	28	2.0	11	2.6	4.2	216 to 1
Ocular	24	11	1.4	45	19	1.8	8	2.3	3.5	54 to 1
Aural	29	13	1.6	19	8	1.2	–5	2.0	–2.5	10 to 1
Genital	10	5	1.0	7	3	.7	–2	1.2	–1.7	3 to 1
Summary*	267	20	.7	346	24	.7	+4	1.0	+4.0	142 to 1

*Percentages for the summary are calculated with a base of 6 x 221, or 1,326 for the boys; and 6 x 238, or 1,428 for the girls.

These data are in accord with those presented for the oral habits by the successive observation method and are in accord with clinical experience.

The statements of the relation of nervous habits to age in the clinical literature are indefinite and in disagreement. An analysis of the data according to age should supply a quantitative statement. Such an analysis has been presented in the following section for the ages represented in the study.

THE RELATION OF NERVOUS HABITS TO AGE

The data presented in Table XIV and Figure 1 indicate that age differences in the manifestation of oral habits are unimportant. On the whole the medians are remarkably homogeneous considering the size of the samples. The data for the girls are more homogeneous than those for the boys. For normative purposes it would appear that children of all the ages represented may be included in single distributions when the conditions of observation have been the same. The

TABLE XIV

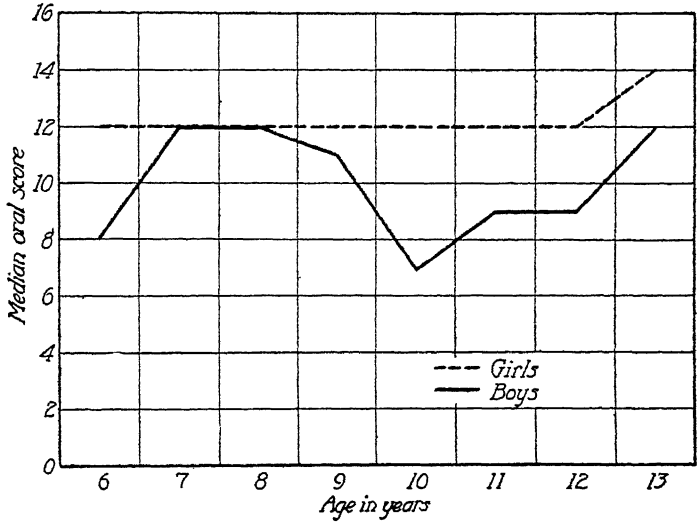
MEDIAN SCORES IN ORAL HABITS BY AGE AND SEX FOR ELEMENTARY AND DEPARTMENTAL GRADES

	Ages										
	6	7	8	9	10	11	12	13	14	15+	Tot'l
El. Boys											
N	13	25	28	32	42	43	32	10			225
Md.	7.8	11.5	12.0	10.5	6.7	9.3	9.3	11.6			9.3
El. Girls											
N	11	33	35	29	49	39	30	16			242
Md.	11.5	12.1	11.5	11.8	12.1	12.1	12.0	14.0			12.0
Dept. Boys											
N							12	35	22	14	83
Md.							6.5	6.8	8.0	6.9	6.9
Dept. Girls											
N							16	33	28	9	86
Md.							6.5	9.9	9.8	8.5	9.5

lower manifestation for the departmental grades persists when children of the same ages are compared.

FIGURE I

RELATIONSHIP OF ORAL HABITS TO AGE



In order to get comparative data to illustrate the effect of age on oral habits a series of observations was made on a small group of University students. The students were members of a summer session class in elementary educational psychology and were, for the most part, teachers of experience. Twenty observations were made in two recitation periods on successive days beginning at 8:00 in the morning. Four men are included in the total of twenty-two cases and their mean is lower than that for the women. The mean (10.7), median (10.3), and standard deviation (4.5) are practically identical with the same constants for the first six grades of the elementary school and point again to the absence of a growth curve.

TABLE XV

THE RELATION OF NERVOUS HABITS TO AGE

HABIT	AGES							
	6 (24)		7 (58)		8 (61)		9 (59)	
	N	Per Cent	N	Per Cent	N	Per Cent	N	Per Cent
Oral	12	50	32	55	32	52	35	59
Nasal	9	38	15	26	13	21	18	31
Hirsutal	8	33	18	31	13	21	10	17
Ocular	2	8	9	16	4	7	9	15
Aural	5	21	5	9	11	18	8	14
Genital	1	4	2	3	3	5	3	5
Summary	37	26	81	23	76	21	83	23

TABLE XV—*Continued*

THE RELATION OF NERVOUS HABITS TO AGE

HABIT	AGES									
	10 (90)		11 (80)		12 (62)		13 (25)		All (459)	
	N	Per Cent	N	Per Cent	N	Per Cent	N	Per Cent	N	Per Cent
Oral	46	51	47	59	31	50	12	48	247	54
Nasal	22	24	25	31	16	26	9	36	127	28
Hirsut.	18	20	17	21	14	23	7	28	105	23
Ocular	10	9	19	24	14	23	2	8	69	15
Aural	4	4	7	9	3	5	5	20	48	10
Genital	4	4	0	0	2	3	2	8	17	4
Sum.	104	19	115	24	80	22	37	25	613	22

Note: The bases used in the calculation of percentages are given in parentheses following the ages. The bases used in the summary are six times these values.

The data for single observations analyzed by ages (Table XV) are fairly homogeneous. The probable errors of the percentages in the summary vary between 1.1 per cent and 2.5 per cent. The most extreme difference found (between

ages six and ten) is only 2.6 times the probable error of the difference. For the most part the fluctuations in the specific habits for various ages seem ascribable to sampling errors. There is some evidence that there is an increase in ocular habits at ages eleven and twelve. The best conclusion from the data available is that nervous habits are constant over the ages considered.

SUMMARY

The results of the application of the revised techniques to an elementary school population and to a group of adults have been presented in this chapter. The data indicate that nervous habits are distributed in the same fashion as measures of mental and physical traits. The amount of nervous habits appears to be unaffected by age, but a real sex difference has been established. The girls have, in general, larger amounts of the nervous habits studied. In the elementary schools a selected group of nervous habits reveals an order of frequency as follows: oral, nasal, hirsutal, ocular, aural, and genital. For an extended observational program more data can be obtained in a given amount of time by using the more frequently occurring groups of habits.

After a method for stating nervous habits in quantitative terms had been developed, it became possible to study the genesis of nervous habits and the possibilities of developing differential tests and measures. An attack on the first of these problems will be presented in the following chapter.

CHAPTER VI

THE GENESIS OF NERVOUS HABITS IN CHILDREN

In previous chapters a method for measuring nervous habits in children has been developed, and these habits have been related in quantitative terms to such factors as age and sex. No new material has been presented, however, which describes the development of nervous habits in children. The origin of nervous habits is of considerable theoretical and practical interest. The continual problem of nature vs. nurture is insistent in data of the kind reported here. The practical requirements of prevention and treatment demand a careful knowledge of etiological factors. It is difficult to attribute causality to such factors as can be quantitatively related to nervous habits. There is no certainty in any particular instance that one factor is a cause and the other an effect, or vice versa. Further, an association between factors may occur, due to the operation of variables not touched upon in the analysis. Since every condition is a problem in multiple causation, the need for caution in interpreting a given association is clear. As a matter of description, however, it seems desirable to study relationships that suggest, even though they do not demonstrate, causation.

An analysis of some of the factors apparently involved in the genesis of nervous habits is presented in this chapter. Oral records were available for an entire elementary school population and a small group of preschool children together with a variety of supplemental data. While the measure of nervous habits has been the oral records, a greater degree of generality for the results may be assumed than that implied in the specific content of the oral observations.

FAMILIAL RESEMBLANCE AND FAMILY HISTORY

The clinical literature stresses the fact that tic patients frequently belong to families of which other members are also affected with some form of functional nervous disorder. Numerous studies have been made of the similarities between

brothers, sisters, brothers and sisters, and twins in the fields of physical, mental, and educational tests. These studies suggest at once the possibility of attacking the problem of the extent to which individuals resemble each other in nervous habits due to membership in the same family.

Oral records were available for forty pairs of brothers, twenty-five pairs of sisters, and seventy-one pairs of brothers and sisters located in grades one to six in the same school. Data were also available for six pairs of twins. The problem was attacked by the method of correlation. Male–male, female–female, and male–female comparisons were made separately. In the case of the male–male, and female–female comparisons, double entries were made to avoid systematic errors. For these correlations the value of N is twice the number of pairs represented. In the case of the male–female comparisons the male score was entered as the X variable and the female score as the Y variable. It can easily be demonstrated that the double entry method may be employed with validity only when the means of the compared series of pairs are about the same. Since girls are consistently higher at all ages than the boys, the double entry method would tend to negate the existing correlation. The condition of equal means for children of different ages may be assumed as approximately satisfied. The Pearson coefficient of correlation was calculated in all cases except the twin comparisons where the Spearman rank-difference method was used. As might be expected the resemblance between twins is the highest

TABLE XVI

FAMILIAL RESEMBLANCE IN ORAL HABITS

COMPARISON	N PAIRS	COEFFICIENT OF CORRELATION
Sisters	50	.32
Brothers	80	.16
Brothers and sisters	71	.09
Same sexed twins	6	.83
Boy-girl twins	6	.46
All twins	12	.78

(Table XVI) and is higher for the same sexed twins than for those of different sex. The values of .78 for all twins, .83 for the same sexed twins, and .46 for different sexed twins, do not have a large amount of stability because of the small number of cases involved. Sisters resemble each other more closely than do brothers with the intersex comparison showing the smallest degree of resemblance. These data establish a probability that children of the same family will resemble each other more closely than children in general. They tell nothing in a crucial way as to the relative importance of a familial neurotic predisposition and environmental factors.

Family histories were available for a group of thirty-three preschool children. Of the thirty-three children, seven were found whose medical history blank revealed data that might have some significance as indicating a familial predisposition to nervous disorders. In these cases there was either a record of mental disease on the part of parents, aunts, or uncles, or the families or parents were characterized as "nervous." The incomplete character of these data must be admitted and the difficulty of securing reliable records of this type is well known. Since, however, complete records were available for the entire group for fourteen ten-minute observations of oral habits and for one hour's observation of the combined categories, it seemed worth while to see if children with a neurotic family history exceed the others in their possession of these habits. The averages would indicate that this is actually the case. The mean oral score for the neurotic group was 9.1 as compared to 7.1 for the non-neurotic. The corresponding values for the one hour of observation on the combined categories were 7.4 and 5.4. Because of the small number of cases no attempt has been made to calculate the statistical significance of the differences between the groups. While the data reported constitute very meager evidence from the numerical point of view, the results are self-consistent and consistent with the facts noted by clinicians.

IMITATION AS A FACTOR IN NERVOUS HABITS

The existence of *imitation* as a mechanism inherent in the human organization has been disputed. The writer is not

concerned here with a defense or a denial of the existence of such a mechanism. The word imitation will be used as a label to designate the tendency, if it exists, for one individual to behave like a second when he is stimulated by the behavior of the second without the presence of a common stimulus to which both are responding. The problem of whether or not children will imitate nervous habits is of considerable practical importance.

It will be recalled that the observations on oral habits were collected on seating charts of the room. If imitation is a factor in the production of these habits, its operation should be such as to make children who sit in adjacent seats more alike in this respect than children selected at random. The existence of such a factor might be determined in a number of ways. The method of correlation has been applied to the problem.

By using each child as an X entry and an adjacent child as a Y entry it is possible to test the existence of correlation (method A). The stimulation from the adjacent seats would be primarily visual and only to a slight degree auditory. It would seem preferable to pair with each individual only such children as sit at the left, left oblique, front, right oblique, and right.

A second method (B) would be to pair each individual with the average of his associates. This method increases the correlation slightly by reason of the greater reliability of the Y entry and by the fact that systematic errors due to sex differences would be decreased. The labor of tabulation and computation is also less by this method than the first.

A third method (C) would be to correlate the score for each child with the distance from the center of gravity of the chart with respect to oral habits. Such a method has the advantage of taking into consideration all of the children in each room with respect to each child. Such correlations, however, are apt to be spuriously high because the location of the center is in itself a function of the individual measures. Use has been made of methods A and B in the present investigation. Method C was discarded after a preliminary trial.

To avoid dangers of selection from the data, all charts for all rooms from grades one through six were studied by either method A or B or both. The charts gave the location of the child as on the day of the observation. It is evident that recent changes in the seating arrangement of the room might materially affect the relationship found by the methods used. It was, therefore, necessary to have a record of such changes at hand in the interpretation of the results. A seating chart had been made for each room at the beginning of the semester. The observations were made from two and one-half and three and one-half months later. By comparing the first chart with the second chart the number of changes in the interim could be readily ascertained. The importance of this information may be appreciated when it is realized that moving a child out of one location changes his combina-

TABLE XVII

INFLUENCE OF "IMITATION" ON ORAL HABITS

CHART No.	GRADE	CHANGES		METHOD A		METHOD B*	
		No.	Per Cent	r	N	r	N
1	2A-3B	3	9	.30	129	.45	32
2	5A	2	6	.21	114	.43	35
3	6A	1	3			.40	34
4	1A	3	9	.21	109	.33	34
5	6B	3	9			.20	35
6	3A	1	3	.02	122	.18	34
7	1A-2B	3	13	−.01	56	.17	23
8	4A	10	29	.06	131	.07	35
9	5B	12	32	.02	153	.04	38
10	2A-3B	5	14			−.15	37
11	2A-2B	9	24			−.27	37
12	5A	11	39			−.29	28
13	1B	7	23	−.18	96	−.33	30
14	4B	33	100			−.41	33
15	6A	6	21			−.57	28
Summary (changes 15 per cent or less)						+.28	195

*The Spearman (rank-difference) correlation between number of changes and the size of the Pearson r is .78.

tion with from 1 to 5 children in that location and introduces his record in a new combination of from 1 to 5 children.

Table XVII is to be read as follows. Chart number 1 is for a group of thirty-two children in grades 2A-3B. The seats of three children were changed during the three months' period between the opening of the semester and the time the records were made. If each child is used as an *X* entry and his associates as a *Y* entry, 129 pairs of measures are secured with a relationship indicated by a coefficient of correlation of .30. The correlation between the record of each child and the average of his associates is .45. If nothing but chance determined the correspondence between each child and his associates, the correlation should be zero, or approximately zero.

The coefficients range from —.57 to +.45. They are meaningless, however, unless interpreted in the light of the changes that have been made. The number of individuals changed and the percentage of the total group is given for each room. The percentage of the total group affected by each change will of course be much larger. The Spearman coefficient of correlation (rank-difference method) between the percentage of seats changed and the size of the coefficient of correlation is .78. In the case of the negative correlations the changes have been so numerous as to affect the pairings of the majority of the children in the room. A combined correlation for charts 2 through 7 gives a correlation of .28 $\pm$ .04.[1]

The sizes of the coefficients are too small by reason of a number of factors of which the following are probably most important:

1. The correlations would be increased by greater time and accuracy of observation. A statistical correction can be made for the unreliability of the measures.

2. The method of pairing is only an approximation to the conditions under which the child is stimulated. Actually the effective stimulation may often come from beyond the immediate associates. The correlations would be too low as

[1]Chart 1 is omitted because it was based on ten ten-minute observations rather than twenty five-minute observations.

a test for the amount of imitation because the method of its operation is only approximated.

3. The changes in the seating arrangement during the semester have arbitrarily detracted from the size of the coefficient. This factor is revealed by the high rank order correlation between the frequency of such changes and the size of the coefficient. A remedy for this would be to cooperate with a group of teachers to maintain the same seating arrangement over the experimental period. The data reported here describe simply what happened during the course of the investigation and are an unplanned incident of the experiment.

4. The correlations are reduced somewhat by the presence of a double entry error in the inclusion in both the X and Y categories of boys and girls who vary about different means.

There are two types of negative criticism that may be offered concerning the acceptance of the obtained values as indicative of the presence of imitation in the manifestation of oral habits. In the first place it might be contended that the observer did not divide his attention evenly over the room. This would result in agreement among areas and would be reflected in the coefficient. This argument seems easily refuted. Observations were made subsequent to all changes in seating. If differential attention were the factor at work there should be no agreement between the size of the coefficient and the number of changes that had occurred in the seating diagram. A second possibility is that children of similar constitution tend to choose adjacent seats. This would result in correlations that would be negated by subsequent changes. A conclusive answer to this objection cannot be given from the data. Certain possibilities, however, may be analyzed. The grouping in each room was made by the teacher by grade or by sections according to ability. The opportunity for pupil choice is very restricted as a result. If spurious correlation is looked for as a result of the teacher's arrangement it must come from the correlation of oral habits with intelligence, age, or achievement. Significant correlations of this kind have not been found.

It seems probable that the data presented offer some evidence of the *existence* of imitation as a factor in nervous

habits but do not answer the question of its *amount.* Because of the disagreement among psychologists concerning the existence of this factor it would seem worth while to use the technique proposed, or modifications of it, under carefully controlled conditions in further experimentation. The method would be applicable to mental, physical, and social data, and to the solution of a variety of problems in social psychology.

A probability has been established that oral habits are in part learned behavior—resting, it may be, of course, on a neurotic predisposition of varying degrees, but dependent somewhat on environmental circumstances. The similarities reported among brothers and sisters and twins might be ascribable either to a similar biological constitution or to association, according to the point of view. In the light of the data on family history it seems probable that it is ascribable to both.

Further light is thrown on the problem by an analysis of the relationship of breast feeding to oral habits in young children.

BREAST FEEDING AND ORAL HABITS

From the survey of the literature it will be recalled that the writers are unanimous in considering tics to be dependent on a neuropathic constitution and that the specific form of tic is dependent on a particular exciting stimulus which is repeated with such frequency that the habit is fixed and persists after the stimulation has disappeared. If the latter portion of this statement is true, young children who have suckled for a long period of time should have more oral habits, hereditary factors being constant or equalized, than do children who have suckled for a short period of time.

By reference to the medical history of the child collected by the Institute of Child Welfare, a record of the length of time for which the child was breast fed was secured. The records for bottle feeding and mixed feeding were not available. No information concerning the reliability of these records is available. They were collected from the parents when the children were two and three years of age and are subject to errors of memory except in the cases where a record was kept.

TABLE XVIII

THE RELATION OF ORAL SCORES TO LENGTH OF BREAST FEEDING

CASE NUMBER	ORAL SCORE	MOS. OF BREAST FEEDING
1	14	8
2	13	9
3	13	9
4	13	7
5	13	3
6	12	15
7	12	10
8	12	9
9	12	7
10	11	7
11	11	5
12	11	3
13	9	6
14	9	5
15	9	0
16	8	7
17	7	6
18	6	6
19	5	8
20	5	0
21	4	8
22	4	5
23	4	2
24	2	12
25	2	8
26	1	9
27	1	0
28	0	13
29	0	9
Mean	7.7	6.8

Table XVIII gives the relationship between months of breast feeding and oral records. The Pearson coefficient of correlation between the variables is but $.03 \pm .12$. The re-

gression, however, is curvilinear and the relation should properly be studied by means of the correlation ratio. The value for one of the ratios is .698. This is reduced to .353 by using Pearson's correction for number of cases and fineness of grouping. The relationship is illuminated somewhat by a study of the extreme cases. Nine children have oral records of 12 or above. Eight of these nine are to be found at or above the average of the group in terms of the length of time they were breast fed, i.e., long breast feeding seems to be a determining factor in the formation of persistent oral habits. An examination of the records of the children who were not breast fed or were breast fed less than one month reveals that one of the cases is about average in oral habits and the other two are below, i.e., absence of breast feeding does not produce persistent oral habits. There are, however, an appreciable number of cases who have been breast fed longer than the average time and still have low oral records, thus giving the curvilinear form to the relationship.

The data as they stand are difficult to interpret in an unequivocal fashion. In the first place, information concerning the total period of feeding at breast and bottle was not available and there is no evidence to substantiate the assumption that the breast is a more potent stimulus in habit formation than the bottle. The best conclusion is that long breast feeding is one factor in establishing persistent oral habits at early ages. Even here, habit as an etiological factor is probably cut across by hereditary and other environmental factors. For example, is the nervous child harder to wean, nursed somewhat longer, and the high oral records explainable consequently on the grounds of both heredity and habit? On the other hand, many nervous children do not learn to feed properly, and nervous mothers are poor nurses. Another factor cutting across the determinations is that of nutrition. It will be shown that the child of poor nutritional status has a larger number of oral habits on the average than the well-nourished child. Some of the exceptional cases may be due to the operation of the relations of nutritional status to oral habits and breast feeding.

The problem is of considerable practical concern to parents, psychologists, and pediatricians interested in feeding and in breaking oral habits, and should be studied in greater detail. More extended study has been impossible in the present research.

FATIGUE

A large number of persons are concerned with the effect of the school on the nervous health of the child. It would be of particular interest to secure a quantitative statement of the effect of the fatigue resulting from the school day on nervous manifestations. Fatigue as used here does not refer to a lowered capacity for doing physical and mental work, but to a decreased "tonicity" or an increased "irritability" of the nervous system which increases the number of nervous symptoms.

The results to be presented here are based on the analysis of data accumulated incidentally during the course of the investigation. In the preliminary study, fourteen ten-minute observations of oral habits were made on a group of thirty-eight second grade children. The fourteen observations were divided according to whether they had occurred in the morning or the afternoon and the percentage of children manifesting the habit calculated for each period. In no case was the percentage as high in the morning as the lowest in the afternoon. The average percentage of children showing the habits was 34 per cent in the morning as compared to 52 per cent in the afternoon.

Twenty five-minute oral observations were made one afternoon on thirty-one children in the fifth grade. One month later a similar set of observations was made in the morning on the same children. The mean manifestation in the morning was 9.5 with a standard deviation of 5.0, while the same values for the afternoon were 11.0 and 4.9, respectively. The odds are 3.45 to 1 that the greater manifestation in the afternoon is not due to errors of sampling.

Twenty five-minute observations were made in the morning in each of the rooms. On the same afternoon single observations of oral, nasal, hirsutal, ocular, aural, and genital

habits were made. Comparison of the first five-minute oral observation in the morning with a five-minute oral observation at the beginning of the afternoon reveal percentages of manifestation of 54 per cent and 52 per cent, respectively. The difference has little significance in terms of the probable error. It is possible that the luncheon hour restores the tonicity of the nervous system and obscures any of the fatigue effect that might otherwise be apparent.

It seems probable that fatigue is one of the factors in the multiple causation of manifestations of nervous habits. The whole problem should be subjected to systematic investigation.

FREUD'S HYPOTHESIS

As discussed elsewhere, Freud has claimed that oral habits are an expression of infantile sexuality. Moll contends, however, that the frequent observation of the simultaneous occurrence of oral habits and masturbation is simply due to the fact that both are symptoms of an underlying neuropathic predisposition. Support of Freud's theory as against Moll's must come from a demonstration that oral habits are more closely allied to masturbation habits than to nervous habits in general.

It will be recalled that single five-minute observations were made of oral, nasal, hirsutal, ocular, aural, and genital habits. A single observation is, of course, an unreliable measure. How unreliable it is may be judged by the biserial coefficient of correlation between the oral record on twenty observations for those who were caught in the single observation versus those who were not. The coefficient is + .33, which is much lower than the intercorrelations obtained with the more reliable methods.

The average oral record on twenty observations for those in each of the single observation categories gives some idea of the relationship of each category to oral habits. The results (Table XIX) indicate that the single oral category will be most closely related and that the hirsutal category has no relationship.[2] Genital habits show a lower relationship than

[2]More reliable data elsewhere establish some relationship.

TABLE XIX

THE RELATION OF ORAL SCORES TO SINGLE FIVE-MINUTE OBSERVATIONS OF VARIOUS NERVOUS HABITS

HABIT	BOYS		GIRLS		TOTAL	
	Mean with	Mean without	Mean with	Mean without	Mean with	Mean without
Oral	10.6	8.5	12.7	10.2	11.8	9.4
Nasal	10.1	9.3	12.4	11.4	11.3	10.5
Hirsutal	9.3	9.5	11.9	11.6	10.7	10.7
Ocular	9.5	9.5	12.5	11.5	11.5	10.6
Aural	10.8	9.3	11.8	11.7	11.2	10.6
Genital	10.1	9.4	12.4	11.7	11.0	10.7

do nasal, ocular, and aural habits. Freud's theory receives no support from these data. This does not mean that the association of oral habits and masturbation will not be observed frequently, but it raises a question whether there is a causal relation for the association. The association of the two seems clear in certain extreme cases encountered in the study. They are not, however, unselected cases—they are extreme cases from the standpoint of genital habits, and the high oral records may be simply another symptom of the underlying predisposition. Certainly the sexual factor in the etiology of oral habits does not deserve elevation to the dignity of a generalized explanation of these phenomena.

THE RELATION OF NERVOUS HABITS TO NUTRITIONAL STATUS

The association of neurotic symptoms and poor nutritional status has been frequently noted in the clinical literature. The importance of this factor in the minds of some students of the problem is well illustrated by the following statement from Holt: "Most of the neuroses of childhood depend entirely upon disorders of nutrition. The headaches, insomnia, disturbed sleep, chorea, habit spasm, hysterical manifestations, and a multitude of others are relieved only by correcting the faulty diet and habits which are the basis

of the disturbed nutrition."[3] Speaking more generally, Emerson says. "Undernutrition and mental stability cannot go together."[4] Kretschmer has elaborated a thesis on the relation of the extremes of physique to the manifestation of the two great groups of psychoses—the manic depressive and schizophrenic.[5] At the one extreme he finds the asthenic type of build associated with the schizophrenic and at the other he finds the pyknic type associated with the manic depressive. Naccarati also concluded that psychoneurotics were found at the extremes of body build according to the morphologic index used.[6] The figures collected by insurance companies further indicate a greater incidence of psychoses among those of low body weight with respect to height. Mateer has called attention to the fact that qualitative deficiencies in nutrition may aggravate the clinical symptoms of instability.[7]

In relating the occurrence of nervous habits to nutritional status, oral scores have been used as the measure of nervous habits and the ponderal index as one measure of nutrition. The use of this measure as an index of build is described by Bardeen.[8] The formula is:

$$\text{Ponderal Index} = \frac{\text{Weight}}{\text{Height}^3}.$$

For convenience in general use the value is multiplied by 1,000.

[3]L. E. Holt, *Food, Health, and Growth* (New York: The Macmillan Co., 1922), p. 41.

[4]Charles P. Emerson, "Mental Hygiene: Wise and Unwise Investments," *Mental Hygiene* (July, 1926), 10:459.

[5]E. Kretschmer, *Physique and Character* (New York: Harcourt, Brace and Co., 1925).

[6]S. Naccarati, "The Morphologic Basis of the Psychoneuroses," *American Journal of Psychiatry* (1924), 3:527-544.

[7]Florence Mateer, Calcium Deficiency as a Factor in Mental Instability. Address before American Psychological Association, Ithaca, New York, December 30, 1925.

[8]C. R. Bardeen, "The Height-Weight Index of Build in Relation to Linear and Volumetric Proportions and Surface-Area of the Body during Post-Natal Development," *Contributions to Embryology*, No. 46.

It will be seen from the nature of the formula that children who are heavy in relation to their height will secure a high index and those who are light will have a low index. The indices are useful for a study of groups. They do not, however, take into consideration qualitative differences in nutrition and may not be applicable in individual instances as a quantitative measure of nutrition because of normal variations in build.

The study of the relation of nervous habits to nutritional status was first conducted in the Institute of Child Welfare. The measurements of height and weight were made by Dr. Edith Boyd under the direction of Dr. R. E. Scammon of the Anatomy Department of the Medical School of the University of Minnesota. The measurements used were all made within a two weeks' period and are based on one weighing and three determinations of length. For the preschool data the indices are in terms of gram-centimeters. The value of the index was not multiplied by 1,000 for the preschool data.

Zero order coefficients of correlation were calculated between the following variables: oral score, ponderal index, and chronological age. The most pronounced relationship ($r = -.66$) is that between age and ponderal index. This value indicates the tendency of the ponderal index to decrease with age over the period covered and suggests the desirability of holding age constant in the study of relationships. The zero order correlation between oral habits (y) and ponderal indices (x) is $-.068$. This jumps to $-.203$ when the effect of chronological age is partialed out. Actually the relationship may be curvilinear and the true relationship higher than the obtained Pearson r. The correlation ratios are .47 and .70 for eta_{xy} and eta_{yx}, respectively.

The relationship was next determined on a larger scale for all ages from seven through twelve in the public school. For the most part the measures of height and weight were made by the school nurse in a period of from one to four months preceding the time of obtaining the oral records. Needless to say the measures were not made with the same accuracy as the preschool measurements. They are, however, sufficiently accurate for the purpose.

TABLE XX

RELATIONSHIP BETWEEN ORAL SCORES AND PONDERAL INDICES

AGES	N	r	eta_{xy}*	eta_{yx}
3½	32	−.20**	.47	.70
7	48	−.28	.72	.47
8	56	−.22	.55	.61
9	53	+.11	.61	.43
10	81	+.01	.48	.36
11	78	+.01	.59	.43
12	70	−.04	.47	.63

*Where x = oral scores and y = ponderal indices. Corrections for N and fineness of grouping have not been applied.

**With C. A. constant.

Because of the tendency of the ponderal index to decrease with age it was considered advisable to work out the correlations by age groups. The Pearson coefficient of correlation and both correlation ratios were determined. It will be seen (Table XX) that at the younger ages there is a tendency for the underweight child to have a larger amount of nervous habits as measured by the oral scores. Beyond age eight, however, the Pearson coefficients do not appear to be significant. At all ages, however, the relationship appears to be best described by the correlation ratio. For illustrative purposes a test of linearity has been applied to eta_{xy} for ages seven, ten, and twelve.[9]

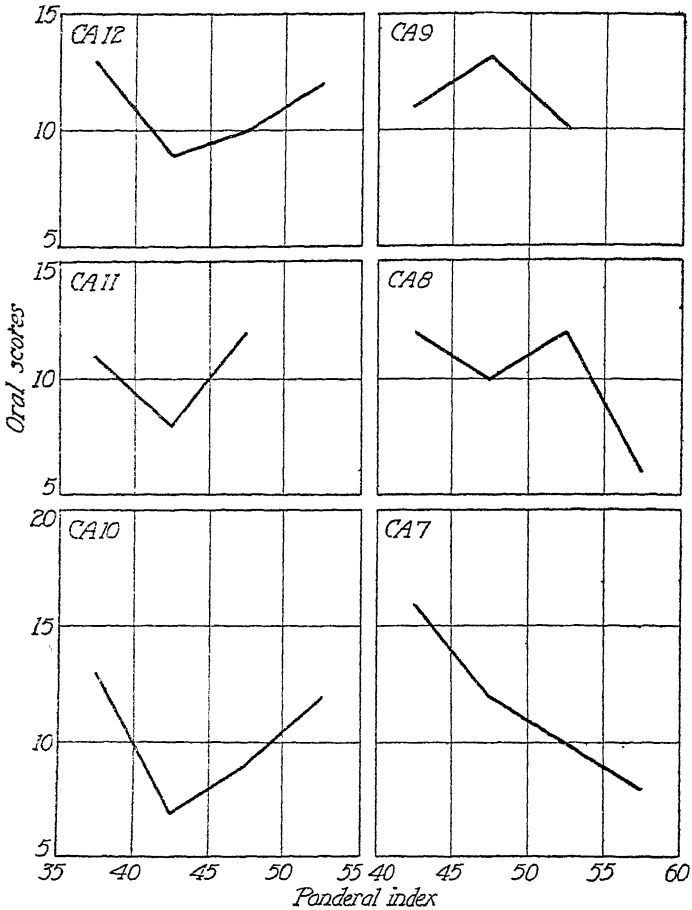
The probabilities that the relationships are curvilinear are respectively about 5,000 to 1, 200 to 1, and 80 to 1, and establish clearly the non-rectilinear nature of the regression. An analysis for these same ages by sex indicates that the curvilinearity is not imposed on the relationship because of sex differences in the two traits. The probabilities of curvilinearity for the boys run 1,000,000 to 1, 1,500 to 1, and 330 to 1; and for the girls, 416 to 1, 175 to 1, and 120 to 1.

To illustrate further the relationship of nutritional status

[9]T. L. Kelly, *Statistical Method* (New York: The Macmillan Co. 1923), pp. 238-239.

FIGURE 2

RELATIONSHIP OF ORAL SCORES TO PONDERAL INDICES



as determined by the ponderal index to nervous habits as measured by the oral scores, the relationships for each age have been plotted (Fig 2). Reference to the median index

for ages twelve, eleven, and ten reveals that the average group of children have the smallest amount of the habit and that extremely underweight and overweight children have larger amounts. The relationship in age nine is irregular and at ages eight and seven an overweight condition seems desirable as compared to the median and underweight conditions. There are, of course, variations in the curves due to sampling errors. In general, however, it may be said that in terms of nervous habits the underweight condition is undesirable at all ages. The overweight condition is undesirable at the upper ages with some amount of overweight apparently desirable at younger ages.

TABLE XXI

COEFFICIENTS OF CORRELATION BETWEEN WEIGHT (y) AND ORAL RECORDS (x)

AGE*	BOYS		GIRLS		TOTAL
	r	eta_{xy}	r	eta_{yx}	r
7	−.20	.43	−.22	.61	−.19
8	+.22		−.21		−.01
9	−.13		+.06		−.06
10	−.11	.41	+.04	.41	−.02
11	−.04		−.27		−.15
12	−.04	.37	−.27	.77	−.19
13	−.28		−.01		−.13

*N as in Table XX.

In order to push the analysis a step further it appeared advisable to work out the relationship between oral scores and weight for constant age groups. The results (Table XXI) give slight negative relationships for all age groups with eleven out of the fourteen coefficients negative when analyzed by sex. Here again the underweight conditions is undesirable. An examination of the correlation ratios for ages seven, ten, and twelve again indicates higher relationships. The probabilities of curvilinearity are not as high, however, as when ponderal indices are used. For the boys they run in order 2

to 1, 3 to 1, and 3 to 1; and for the girls, 37 to 1, 5 to 1, and 174 to 1, for the age groups studied by this method.

When a child in the Minneapolis Public Schools is 10 per cent or more underweight a recommendation is made that he attend an open-air school. The actual transfer to the school is made with the consent of the parents. At this school special medical attention is given, the children are fed, the school periods are shortened, and a portion of the day is devoted to sleeping.

Since the children in such a school are all considerably underweight it might be expected that they will have a larger number of nervous habits than children in general. On the other hand, the feeding program and attempts to avoid fatigue might tend to alleviate the condition.

The writer observed one class in an open-air school with the use of the revised techniques. The median scores by age and sex (Table XXII) are higher than the corresponding scores for the general population. Sixty per cent of the girls and 64 per cent of the boys in the general population would have lower scores than the medians for the underweight girls and boys.

TABLE XXII

COMPARISON OF ORAL SCORES FOR A COMBINED FOURTH AND FIFTH GRADE IN A SCHOOL FOR UNDERWEIGHT CHILDREN WITH THE ORAL SCORES FOR ELEMENTARY CHILDREN IN GENERAL

	BOYS		GIRLS		TOTAL	
	N	Md.	N	Md.	N	Md.
Underweight	11	11.5	10	13.0	21	12.5
Norm	225	9.3	242	11.7	467	10.7

These data supplement and confirm the previous findings although the numbers involved are not large. The extent to which the nervous habits have been alleviated by attendance at the open-air school cannot be determined from these data.

An association between nutritional factors and nervous

habits seems clear. Whether the association is causal and based on controllable factors of nutrition is not as easily demonstrated. The experience of clinicians in dieting neurotic cases indicates a causal nexus.

Since the ponderal index is not only a reflection of nutritional status but also of body build there is the possibility that the increased nervous habits at the extremes are, in part, symptoms of maladjustment. The writer has shown elsewhere that children who are at the two extremes of such traits as strength, energy output, and susceptibility to fatigue become behavior problems in the public school in larger measure than those at the average.[10] There is also the possibility that the differentiation at the extremes represents the normal analogue of Kretschmer's psychotic differentiation at the extremes of body build. It is further possible that both nutritional status and nervous habits are concomitant variants of an unexplained relationship in physiological chemistry. Metabolism data would be a desirable addition to the present measures in an effort to solve this problem.

The possibilities that have been cited indicate the difficulties encountered in interpreting the data. The presence of a relationship between nervous habits and nutritional factors seems clear. The results do not give a basis for anything more than speculation concerning the *why* and *how* of the relationship. On the descriptive level, however, nutritional status as measured by the ponderal index or weight is revealed to have an important relationship to nervous habits as measured by oral scores. The relationships are called important, not because of the size of the coefficients found, but because of their consistent direction. It is probable that if a more elaborate criterion of nervous habits were to be built up the size of the relationship would increase.

EXPERIMENTAL DEVELOPMENT OF TICS

The clinical literature seems agreed that any irritation may in some cases stimulate movements that are later retained after the exciting stimulus has disappeared. This sug-

[10]Willard C. Olson, *Problem Tendencies in Children* (Minneapolis: The University of Minnesota Press, 1929).

gests that it should be possible to develop such movements in an experimental situation.

In the present research, extensive observations have been made on nervous habits in children. The habits observed were largely those in which the hands and head were involved. This suggested to the writer that similar observations could be made on animals. Some preliminary experimentation was conducted on rats and the following experiment was then performed.

Four animals were chosen from the same litter at the age of eighty-nine days. One male and one female were used for controls and a similar pair for experimental animals. During the course of the experiment all animals were fed on a commercial bran mash. The animals were placed in a four compartment cage in the following order from left to right:

1. Experimental Male
2. Control Female
3. Experimental Female
4. Control Male

A Whipple stop clock was mounted immediately behind the cage so that time could be readily obtained in seconds.

All movements of the legs to the neck and head area, as in scratching, cleaning, etc., were included in the observations. One such movement in a fifteen-second period constituted the unit of measurement. Forty consecutive fifteen-second observations were made on each of the animals individually. The percentage of observations in which the described movements were noted are given for the experimental and control animals opposite Observation 1 in Table XXIII. There is no significant difference in the manifestation of the habits in the two groups.

On the following day collodion was applied to the tip of the right ear of animal No. 1 and allowed to dry. Forty fifteen-second observations were again made. The process was repeated with animal No. 3. Animals Nos. 2 and 4 were handled and observed in a similar manner except that collodion was not applied. The application of collodion resulted in a

variety of removing and cleaning movements on the part of the experimental animals and this fact is reflected in the percentages opposite Observation 2 in the table.

TABLE XXIII

COMPARISON OF EXPERIMENTAL AND CONTROL ANIMALS ON SUCCESSIVE OBSERVATIONS

OBSERVATION NUMBER	AGE IN DAYS	PERCENTAGE MANIFESTATION				$D \div P.E._D$
		Experimental	P.E. Per Cent	Control	P.E. Per Cent	
1	88	26	3	29	3	−0.7
2	89	70	4	50	4	3.5
3	90	29	3	24	3	1.2
4	91	16	3	9	2	1.9
5	91	23	3	24	3	−0.2
6	96	46	4	36	4	1.8
7	118	50	4	29	3	4.2
8	118	60	4	35	4	4.4
9	119	68	4	36	4	5.7

On the following day the ears of animals Nos. 1 and 3 appeared red and irritated and no significant difference appears in the percentages (Observation 3) although the experimental group is slightly higher. The experimental animals were apparently avoiding contacts with the ear at this time.

Forty consecutive observations were made on the fourth day but the method of observation was changed so that all animals were observed simultaneously. This method was used in all subsequent observations. The experimental animals gave a higher percentage but the difference is not large. A new application of collodion was made on the same day, all animals were handled, and the observation repeated. The two groups were about equal in the number of habits.

A sixth observation was made after a lapse of five days. The experimental animals gave 10 per cent more manifestations than the controls and the probability that the difference is significant is about 3.5 to 1.

At the end of twenty-two days the ears of the experimental and control animals were examined with a hand microscope. The irritation had apparently disappeared.

A seventh observation was then made. The chances are 200 to 1 that the obtained higher percentage for the experimental group is not due to sampling errors.

An eighth observation was made on the same day with results that confirm the seventh. The probable significance of the difference is about 300 to 1.

To be certain that an unconscious bias was not affecting the results, the writer had a second observer make a record with the same method on the following day.[11] The second observer had no information concerning the identity of the animals. The experimental animals gave a percentage of manifestation that is 32 per cent higher than the controls with a probability of about 5,000 to 1 that the difference is significant.

If the percentages on the first set of observations are compared with those one month later, it will be noted that the frequency of manifestation has doubled in the case of the experimental animals, while there is no significant difference in the frequencies for the control group.

The object of the present experiment has been to determine whether superfluous movements in the category of tics can be developed in the laboratory. The results indicate that over-stimulation in a restricted area will result in excessive numbers of movements to that area. These movements apparently persist as habit reactions after the disappearance of the original irritation. The study should be repeated with a larger number of cases and over a longer period of time. If the present conclusions are confirmed, the effects of fatigue, nutrition, and other factors on the genesis of nervous habits could be studied experimentally.

Superfluous movements in humans are commonly said to be *nervous* in their origin. When such a term is used, a more general involvement of the nervous system is implied

[11]The writer is indebted to Mr. Alvin C. Eurich, assistant professor, Department of Educational Psychology, University of Minnesota, for assistance with this experiment.

than that concerned with the particular movement or movements. It is possible, of course, that superfluous reactions have an incidence on the general nervous organization that is not beneficent. If that is true, over-stimulation of a narrow kind may result in a more general effect. This suggestion is apparently confirmed by attempts to condition motor reflexes in sheep through electrical stimulation. Too rapid stimulation results in a general nervous involvement rather than in the specific reaction usually elicited. A condition akin to experimental neuroses may be developed.[12] If keys are jangled continually over a cage of rats, a variety of movements are elicited, but if the stimulation is persisted in, the involvement becomes so general that a state of tetany is sometimes reached.

Such evidence as has been presented suggests that habit as determined by repeated responses to an irritating stimulus may be a factor in the formation of nervous habits. This may be true without denying that the general state of the nervous system may be an important factor in the formation of the habit.

SUMMARY

A study of some of the factors involved in the origin of nervous habits has been presented in this chapter. The trend of the evidence suggests that the causation is multiple and that the associations which have been studied are probably only a few of many that exist. In general, it may be said that family predisposition, association with persons of nervous habits, fatigue, habit formation, and nutritional status are factors in the development of the habits studied.

[12]H. S. Liddle and T. L. Boyne, "The Study of Cerebal Inhibition in the Sheep by the Conditioned Reflex Method," *The Psychological Bulletin* (March, 1928), 25:183.

CHAPTER VII

TEST TECHNIQUES FOR THE MEASUREMENT OF NERVOUS HABITS

In the preceding pages the development of an observational method for the measurement of the amount of nervous habits in children has been described. A number of attempts have been made to measure psychoneurotic and related phenomena by test methods. The present chapter is concerned with an analysis of the relationship existing between the observational records of limited, overt reactions in the category of nervous habits and the more complex behavior that certain of the paper-and-pencil tests purport to measure. Some consideration will also be given to tests of narrower psychological functions in their relationship to both the observational records and the results of the tests of psychoneurotic tendencies.

THE WOODWORTH-MATHEWS PERSONAL DATA SHEET

The Woodworth questionnaire with its various revisions has been widely used in a series of investigations concerned with the measurement of emotional stability. The question of the extent to which the device measures the same function as the observational measurements of oral habits is thus of considerable interest. The Mathews revision of the questionnaire was given to eighty-seven sixth grade children and sixty-six third grade children for whom oral scores were available.[1] The Pearson coefficients of correlation between the scores by the two methods are respectively, .06 and —.18. These coefficients would seem to dispose of the possibility that the two methods are measuring any function that they have in common. Closer analysis, however, reveals that the relationships are not linear. With the sixth grade data, for example, the correlation ratios are .41 and .47, and the probability

[1]Ellen Mathews, "A Study of Emotional Stability in Children," *Journal of Delinquency* (1923), 3:1-40.

that the relationship is curvilinear is about 140 to 1. The obtained coefficients are probably obscured by variations in general mental ability. The Pearson coefficients of correlation between scores on the questionnaire and intelligence quotients are — .37 and — .25 for the third and sixth grades, with .60 and .57 for the corresponding correlation ratios. An examination of the correlation arrays showing the relationship between oral scores and Woodworth-Mathews scores indicates that certain persons of high intelligence who make low scores with the questionnaire technique make high scores on the oral technique, while certain persons of low intelligence make high scores on both. There may be here a certain amount of intellectualization of responses to the questionnaire. Those with high intelligence do not commit themselves on the questionnaire in the same measure as those of average intelligence, while those of low intelligence tend to commit themselves in an unrestrained manner. The effect would thus be to vitiate the Pearson coefficient of correlation and impose a curvilinearity on the relationship. This question will be discussed again in connection with data to be submitted later.

The questionnaire was given an item-by-item study in order to determine whether certain questions bear a closer relationship to the oral scores than do others.[2] The complete analysis of all the items in the questionnaire cannot be presented here. One item (21) bears some resemblance to the data obtained in the oral observations, and is thus of special interest, although the relationship is not among the highest of those found. The question asked is, "Do you make your fingers sore by biting your nails?" The qualification of "sore" in the question makes for a dissimilar element, and the method of response does not permit of graded amounts of the habit. The biserial coefficient of correlation between oral records and the children's responses is .27 for the third grade and .09 for the sixth grade. The second coefficient is

[2]A similar analysis was made for each item in relation to intelligence and in relation to the total test. Since this analysis is a digression from the subject matter of the present study it has seemed advisable to report the complete data elsewhere.

lowered by the lesser willingness of older children to commit themselves on the question. Both are lowered by the unreliability involved in the subjective response and by the fact that, on the average, children with low intelligence quotients commit themselves on the question and those with high ones do not. The highest relationship found was with the question, "Are you afraid of the dark?" (item 13). The biserial coefficient of correlation with 150 cases was $.33 \pm .08$. The questions on fears, in general, showed relatively high relationships. Statistical evidence may yet be found for portraying timidity, fear, etc., on stage and screen by biting the fingers or nails or putting the hands to the mouth. It would appear from the data on the relationship between oral scores and the Woodworth-Mathews questionnaire that with the methods of measurement used the two devices have little in common. It has been pointed out that other factors involved in the validity of report may obscure any inherent relationship that exists. The item-by-item analysis of the questionnaire in relationship to oral habits indicates that the highest coefficient found is only about 4 times the probable error of the coefficient.

THE PRESSEY X-O TEST

The foregoing data do not give much basis for confidence that the analysis of relationships of oral scores with similar devices will give significantly positive results. The scores on the Pressey X-O Test given to the same group of sixth grade children mentioned in the preceding paragraphs have been brought into relationship with both the oral scores and the Woodworth-Mathews scores. In the Pressey test the pupil is asked to indicate things that he considers wrong, things worried about, and things in which he is interested. The gross score method is simply the total of such items so that high scores indicate the undesirable condition. When scored according to a differential method devised by Chambers[3] it is called a test of emotional maturity. An in-

[3]Othniel Chambers, "Method of Measuring the Emotional Maturity of Children," *Pedagogical Seminary and Journal of Genetic Psychology* (1925), 32:634-647.

significant coefficient of correlation ($r = .13$) is found between the scores on the test and oral scores regardless of the method used in scoring.[4]

An examination of the Woodworth-Mathews questionnaire and the Pressey X-O reveals that they have, in part, a common content although the method of use is different. Claims are made for the first that it is a measure of emotion instability, and the second is supposed to be a measure of emotional maturity when scored according to the Chambers method. Actually the correlation between them is .08 for eighty-seven sixth grade children. The gross score on the Pressey seems slightly better than the differential score and yields a coefficient of .14. The negligible Pearson correlation existing between the two devices would seem to dispose of a possibility that they are measuring a similar aspect of the personality.

The relationship, however, appears to be a curvilinear one and the most significant correlation ratio is .39. Why should high Pressey scores occur at the extremes of the Woodworth-Mathews scores? The explanation seems to lie in the operation of the factor of general mental ability. A comparison was made of the intelligence quotients for the extreme cases of agreement and for the cases of disagreement, using 20 per cent of the entire number of cases for the comparison. The 10 per cent of agreeing cases have an average intelligence quotient of 96 as compared to 102 for the 10 per cent of disagreeing cases. Some individuals who are unwilling to commit themselves on the questionnaire are apparently willing to commit themselves on the cross-out test where there is a considerable amount of *innocent* material—particularly in the test on interests. These individuals are, on the average, of higher ability than those who commit themselves unreservedly on both devices.

The Pressey test and the Woodworth questionnaire are to some extent a measure of the development that comes with chronological age. This fact is evidenced in the results published by users of the devices and by the data collected in

[4]The total score method and differential score method for these data agree to the extent indicated by a coefficient of correlation of .88.

the present investigation. The decrease in scores with age may be accepted as evidence of an actual situation in emotional development, or may be evidence that with increasing chronological age individuals are increasingly less willing to commit themselves on these devices. The data on the relationship with intelligence would tend to support the second hypothesis as against the first.

As in the case of the Woodworth-Mathews questionnaire, it seems probable that the Pressey X-O Test has little in common with the oral scores. The possibilities of a somewhat different method will be considered next.

FREE ASSOCIATION TEST

In view of the numerous studies by the association method it seemed worth while to spend some time in an analysis of the possibilities of this technique. The test has had two chief lines of development—as a measure of intelligence and as a measure of temperament or personality. Woodworth and Wells[5] early described the association test as one of the best correlates of temperament and concluded that it was less related to education than to temperament. The test was supposed to differentiate two types of temperament: the subjective and the objective. The controlled association method has been widely used in tests of general mental ability but the free association test has not gained popularity in that direction. Because batteries of general intelligence tests were not in current use at the time of the early experiments with the method, it seemed profitable to examine what the tests measure in the light of a test of general ability of known reliability and validity before proceeding to examine their validity in terms of the other measures. The present discussion concerns only the use of the test as a quantitative test with children and not as a qualitative test. The possible use of responses as "complex signs" has not been examined.

The hundred stimulus words in the Woodrow-Lowell revision of the Kent-Rosanoff list were given to a superior

[5]R. S. Woodworth and F. L. Wells, "Association Tests," *Psychological Monographs* (1911), 13:73-85.

section of a 6A grade one month before the close of school. The conditions and directions given by Woodrow and Lowell[6] were adhered to. The median age of the group was 11 years and 10 months and the median intelligence quotient was 109.

The papers were scored by two methods. The total number of individual reactions as defined by Woodrow was first obtained for each child. Low community of response is thus indicated by high scores. The second method was to weight each response by its frequency in terms of the Woodrow table and to secure a total of such weightings. Failures of response were weighted according to the frequency of such failure for each stimulus word. The gross score obtained by this method takes into account every response in the table and its actual frequency, and may be presumed to be somewhat more reliable as a quantitative measure than that obtained by the first method. Low community of response by this method is indicated by low scores.

Some preliminary analysis of what the association test measures can be made with data already available in other sources. Woodrow's table gives the frequency with which each response word occurred in connection with each stimulus word. By counting the number of response words under each stimulus word a measure of the variety of responses that various words elicit may be obtained. What determines the variety of associations? By consulting Thorndike's word book a figure may be secured that represents the frequency with which each stimulus word occurred in an analysis of a large amount of literature. Does the variety of responses to a particular word depend upon the number of situations in which the word is encountered in reading? The correlation between the number of responses to the stimulus words and their frequencies in terms of Thorndike's list is $.58 \pm .04$. Thus words that occur very commonly during a child's experience will elicit a variety of responses, and uncommon words will elicit relatively few responses. This relationship might, at once, call into question the value of the free association method for exploring the emotional aspects of the

[6]Herbert Woodrow and Frances Lowell, "Children's Association Frequency Tables," *Psychological Monographs*, No. 5 (1916).

personality because of the dependency of responses on intellectual experiences and associated intellectual capacities.

Rosanoff's data revealed that large numbers of individual reactions were an indication of immaturity and indicated lack of mental development. Woodrow has shown that Rosanoff's generalization is an artifact dependent on the use of adult frequency tables with children. The number of individual associations as determined by Woodrow's tables were obtained for the children in the investigation and correlated with their intelligence quotients. The coefficient of correlation is $.55 \pm .08$, showing that individual responses in terms of children's tables is a sign of superior mental development and not a sign of retardation. The coefficient of correlation becomes $-.63 \pm .07$ when intelligence is correlated with community or response scores determined by the weighted total. Again, community of response is indicative of inferior mental development and the correlation has been raised by securing a more reliable measure of community.

These findings call into question the generality of Wells's description of the theoretical basis of the free association test as applied to children:

> The theoretical basis is simple; namely, that a person who, under great possibilities of variation, reacts in the association experiment as others do, will find himself in better tune with social situations generally than the person whose reactions tend to be peculiar to himself.[7]

The data obtained here reverse this statement as concerns intelligence. Wells's statement holds when adult frequency standards are applied to people of less intellectual maturity. It will be shown later that as regards other aspects of personality it may be the persons at both extremes who are maladjusted and not simply those of low community of response.

The significant correlation of association with intelligence shows the need for critical examination of claims that the association test taps any other aspect of the personality than general mental ability. The clinical use of the test

[7]F. L. Wells, *Mental Tests in Clinical Practice* (New York: The World Book Co., 1927), p. 223.

where qualitative analyses are made may reveal such aspects of the personality, but the general intelligence factor again implies the need of caution. Claims that psychopathy can be determined from the adult frequency tables by the individuality of responses or that group differences can be obtained are predicated by the assumption that general intelligence is not the effective variable. To prove that the association test contributes something over and above general ability necessitates the experimental control of general ability.

The writer next attempted to determine to what extent the association test (weighted-score method) measured non-intellectual factors. The Pearson coefficients with oral scores, emotional instability (W-M), and emotional maturity (X-O) are insignificant in terms of the number of cases (Table XXIV). The most interesting thing about the relationships, however, is that they are all curvilinear, and are best described by means of the correlation ratio.

TABLE XXIV

THE CORRELATION BETWEEN COMMUNITY OF ASSOCIATION AND OTHER VARIABLES

ASSOCIATION WITH	N	r	eta_{xy}	eta_{yx}
Oral	32	.14	.70	.47
Woodworth	35	.09	.73	.45
X-O	35	.09	.87	.71

The writer ascribes the curvilinearity of the relationships in part to what he has called the "intellectualization of responses." In the association test this may operate so that persons of superior ability who see through the test "cover up," if they have any reason for doing so. An examination of the original correlation array between oral scores and association is of interest. Oral scores have a negligible relationship to intelligence but association scores a pronounced relationship. Thus the children with high oral scores, high community, and low intelligence will be differentiated at one

extreme of the correlation array and children with high oral scores, low community, and high intelligence will be differentiated at the other extreme. An examination of the cases determining the extremes of the relationship confirms this hypothesis. The average intelligence quotient for the four cases of highest community and highest oral scores is 102 and at the other extreme the four cases of lowest community and highest oral scores have an average intelligence quotient of 127. A similar tendency operates for the relationship of association with emotional maturity on the Pressey X-O. The reason here is not so clear since presumably the superior children might "cover up" on the Pressey as well as on the association. An examination of the Pressey test, however, reveals a considerable portion of innocent content upon which superior children might commit themselves. High scores on the Woodworth-Mathews questionnaire are also characteristic of the extremes of association for these data.

It seems apparent from the foregoing analysis that, for this particular sample of the population, general mental ability is more closely related to community of association than any of the other factors studied. There is no evidence that oral habits as measured in the present study have much in common with the results on a free association test. The importance of the relationship of general mental ability to the results of paper-and-pencil tests proposed for studying other aspects of the personality raises the following question for consideration, "Are oral scores similarly related to, or dependent on, the factors measured by a general intelligence test?"

GENERAL INTELLIGENCE

Complete records were available for the Haggerty Intelligence Examination, Delta 2, for all children in the third grade and above in the school in which the observational measurements were made. The relationship between oral records and intelligence quotients has been studied for certain samples of the school population. No significant relationships appear to exist (Table XXV) on the basis of the Pear-

TABLE XXV

RELATIONSHIP BETWEEN ORAL SCORES AND INTELLIGENCE

GROUP	N	r	P.E.
C.A.			
9	46	.05	.10
10	84	−.12	.07
11	83	.13	.07
12	87	−.11	.07
Grade			
6	87	.04	.07

son coefficients. Nervous habits as measured by the limited criterion of oral habits are apparently possessed in about the same amount by individuals at all levels of intelligence. There is some slight evidence in the examination of the regression lines that both the highest and lowest scores are found with relatively greater frequency among those of high intelligence quotients.

In general it may be concluded that an intelligence test has no diagnostic value as an index of the presence of oral habits. The remainder of the chapter will be devoted to a discussion of two tests that are not significantly dependent on general mental ability. The measurement of tremor of the eyelids will first be considered.

TREMOR

Twitching and blinking eyelids are commonly considered as nervous habits in the category of tics. In extreme cases such afflictions are very noticeable. When observational conditions are controlled, however, it becomes apparent that there are wide differences in the normal tremor of the eyelid. Whether this normal tremor is different in kind as well as in amount from that which is ordinarily observed is uncertain. The normal tremor does not appear to be a spasmodic contraction and is not localized as in the case of the extreme

form. It offers, however, a basis for measurement. The present section will be devoted to an analysis of measurements of the normal tremor of the eyelid in relationship to the oral scores as a criterion of nervous habits.

Stecher used a test of tremor in her study of the effect of humidity on nervousness and on general efficiency. Her use of the test may be best described in her own words:

> The observation of the tremor of the eyelids squeezed together until they almost meet is in general clinical use as a diagnostic system of nervous disorder. We merely standardized the observation somewhat by using an arbitrary scale for grading the amount of the tremor. . .[8] After the psychological tests had been completed we graded on a scale of from 1 to 5 the amount of tremor of the eyelids calling no tremor 1 and a very decided flicker of the lids 5.[9]

She concludes that the tremor test has little value as a general index of any but pronounced nervous disorder.

It appeared that the procedure in the tremor test might be so standardized as to give a more reliable measure and more adequate differentiation of a group in less time than was secured under the conditions employed by Stecher. Having such a measure it would be possible to study further the value of the method in the study of nervous stability in children.

In order to utilize this measure with children and to further objectify the method the following procedure was devised:

Examinations are conducted individually. The child stands before the examiner, who asks, "When I say, 'Shut,' will you shut your eyes and not open them until I say, 'Open'?" The command, "Ready! Shut!", is then given. Immediately after the eyes are closed the examiner starts counting the downward movements of the right eye and starts the stop watch simultaneously. When he has counted twenty downward movements he stops the watch, says, "Open," and

[8]Lorle I. Stecher, "The Effect of Humidity on Nervousness and on General Efficiency," *Archives of Psychology*, No. 38, p. 29.

[9]*Ibid.*, p. 35.

TABLE XXVI

DISTRIBUTION OF TREMOR SCORES IN THE KINDERGARTEN

(Median C. A. = 5 yrs. 9 mos.)

Score	Boys	Girls	All
42	1*		1
30		2	2
29	1		1
28			
27			
26			
25	1		1
24	1		1
23		1	1
22	1		1
21		2	2
20	2		2
19	2	1	3
18		1	1
17	1	1	2
16	1	3	4
15	2	1	3
14		1	1
13	1	1	2
12			
11	1		1
10			
9			
8			
7	1		1
N	16	14	30
Median	19.5	18.0	19.0
Mean	19.4	19.7	19.5
S. D.	6.0	5.2	5.7

*Treated as 30 in the calculation of the mean and S.D.

records the amount of the tremor in terms of the time elapsed. Ten seconds are allowed for a rest period between each observation. The number of observations to be made will be dependent upon the reliability desired.

With the foregoing method the need for the subjective estimation of the amount of the tremor is removed. A subjective element remains, of course, in the accuracy with which the downward movements may be counted. The records were made in terms of time for a stated number of movements rather than in movements for a constant time in order to eliminate the error involved in glancing at the watch. By a simple arithmetic operation the movements per any stated interval of time may be obtained. In the present study the records are reported as obtained. Thus large scores in terms of time mean slight tremor and small scores a large amount of tremor. If a more general significance is assumed for the measures, large scores would be interpreted as stability and small scores as instability. This fact needs to be kept in mind in the subsequent interpretation of the differences and the intercorrelations.

The method was first practiced with the examination of thirty kindergarten children—a single measure being taken for each. Since these records were obtained for the purpose of standardizing and practicing the method they have not been used in subsequent interpretations. They are presented here, however, for the information of those who are interested in testing kindergarten children (Table XXVI). Any normative use of these preliminary data should be made cautiously.

Four measures were next secured on each of twenty-nine children in Grade 1B and thirty-five children in grade 2A-3B. There was a gradual improvement in the control over the eye lids in each grade upon successive trials (Table XXVII). The

TABLE XXVII

IMPROVEMENT IN THE CONTROL OF TREMOR OF THE EYELIDS UPON SUCCESSIVE TRIALS

GRADE	MEAN SCORE			
	Trial 1	Trial 2	Trial 3	Trial 4
1 B	15.2	16.7	18.4	19.1
2 A-3 B	12.2	12.5	13.9	14.7

TABLE XXVIII

DISTRIBUTION OF TREMOR SCORES IN GRADE 1B (MEDIAN C.A. = 6 — 5) AND IN GRADE 2A-3B (MEDIAN C.A. = 8 — 6)

	1B			2A-3B		
SCORE	Boys	Girls	All	Boys	Girls	All
27					1	1
26		2	2			
25						
24						
23	1	3	4			
22					1	1
21	2		2			
20		1	1			
19		2	2	2	2	4
18	1		1		1	1
17			0		1	1
16	4		4	1	1	2
15	1		1	3	2	5
14		2	2	1	1	2
13	1	3	4		3	3
12	3		3	1	2	3
11	1		1	1		1
10		2	2		2	2
9					1	1
8				3	1	4
7				3	1	4
N	14	15	29	15	20	35
Median	16.3	19.3	16.4	12.5	14.0	13.8
Mean	16.4	18.2	17.3	12.6	15.0	13.9
S. $D._{dis}$	3.6	5.4	4.7	4.2	4.8	4.7
S. $D._{M}$	.96	1.40	.87	1.09	1.07	.80

frequency distributions for the averages on the four successive trials are given in Table XXVIII. In each grade the girls evidence slightly better control. The odds against the occurrences of such a difference through sampling errors is 2 to 1 in grade 1B and 7 to 1 in grades 2A-3B. The first grade children have a slower tremor than the 2A-3B group,

i.e., the time elapsed for the given twenty tremors is longer. The odds against the change occurrence of the difference indicated is 240 to 1. While the difference seems a significant one it must be accepted with reservations for there is always the possibility that a constant factor other than that of age is operating. Such a factor might be a gradual increase in skill on the part of the examiner in the case of the older group, which was examined last.

From the data is apparent that wide individual differences exist in the possession of tremor in children. The variability as determined by the standard deviation is the same at age 6 years 5 months as at 8 years 6 months. There is some positive skewness under the conditions of the method due to a few cases with a very slow tremor. This skewness may be noted in the relative size of the mean and median in the tables. The mathematical values for skewness were not calculated.

The methods outlined above appear to give adequate differentiation among groups of children. What is the accuracy of the results obtained? An idea of the reliability of each measure can be secured by correlating it with the average of the three remaining measures. This has been done for the first measure in the two groups and coefficients (Pearson) of .80 and .87 obtained (Table XXIX). The values for subse-

TABLE XXIX

RELIABILITY OF MEASURES OF TREMOR OF THE EYELIDS

GRADE	N	METHOD		
		I with II, III, and IV	I with II	Sp.-Br. I, II, III, IV
1B	29	.80	.81	.94
2A-3B	35	.87	.80	.94

quent measures were not calculated. Another method would be to calculate the coefficient between a single measure and a second single measure. These values run lower because of the decreased reliability of a single measure as compared to the reliability of an average of three. The coefficients of cor-

relation between the first and second measure in each group are .81 and .80. In a similar manner the correlation might be calculated for all possible pairs. This would give six intercorrelations for each group and an average intercorrelation could be obtained. The writer felt that the labor attached to the calculation of the entire group of correlations was not justified by their added value.

The average of four measures will have greater reliability than a single measure. The value of the reliability coefficient for the averaged measures becomes .94 in the two groups when the coefficients between the first and second measures are used as typical of the reliability of all the single measures. The error of prediction involved with coefficients of the size reported here is sufficiently small so that confidence can be attached to the accuracy of the result obtained. The probable error of estimate will be about two seconds in the case of a single measure and about one second for the average of four measures.

Although tremor may be measured with fair accuracy, no evidence has been presented that what is measured is of significance in determining tendencies to nervousness in normal children. The clinical use of tremor as a diagnostic test deals largely with extreme cases. The only evidence that can be presented here are intercorrelations with other measures of reputed significance. If an examination of the resulting evidence presents a semblance of uniformity there may be some basis for believing that the test has some more general significance than that determined by its content.

The relationship of tremor scores to other available measures is presented in Table XXX. The cases are few and the coefficients too small to carry much significance. In interpreting the coefficients it should be remembered that high tremor scores, according to the method of measurement, indicate high stability and low scores indicate instability.

In two of the three samples high oral scores go with instability as measured by tremor scores. In the third sample the relationship is about zero. In the sample given, retardation in tapping is an accompaniment of low stability as measured by tremor. This is in accord with the data to be

TABLE XXX

INTERCORRELATIONS BETWEEN TREMOR AND OTHER VARIABLES

TREMOR WITH	GROUP	N	COEFFICIENT OF CORRELATION
Oral	2B-3A	33	−.15 (a)
Oral	1B	26	.01 (a)
Oral	Kindergarten	27	−.10 (a)
Tapping	2B-3A	30	.17 (a)
W-M	2B-3A	34	.19 (b)
Age	2B-3A	35	−.08 (a)
I. Q.	2B-3A	34	+.07 (a)

(a)—Pearson.

(b)—Correlation Ratio ($\frac{x}{y}$) where $y =$ W-M and $x =$ tremor.

presented later on oral records and tapping for children of comparable ages. The relationships to age and intelligence seem of little significance. The relationship to the Woodworth-Mathews scores deserves special consideration. Low tremor scores (high in stability) are found at the extremes of the Woodworth scores. How is this to be accounted for? A comparison of the group of cases at the lower left of the correlation array included in the area bounded by scores of 33 and above on the W-M questionnaire and by scores of 17 and below on tremor, with the group at the lower right bounded by scores of 18 and below on W-M and scores of 17 and below on tremor, reveals a characteristic difference. These groups are comparable in tremor (a test over which they have little control) but the differential factor that determines their placement on the questionnaire is intelligence. The mean intelligence quotient of the high W-M, rapid tremor group is 110, while that of the low W-M, rapid tremor group is 119. This evidence is in accord with that presented elsewhere—that the intellectualization of responses on the Woodworth-Mathews questionnaire obscures the significance of the obtained relationships.

Because of the consistency in the direction of the results the tremor test should be studied with sufficiently large groups to determine whether reliable relationships of this kind ex-

ist. The obtained results indicate that the relationship between a test of a specific phenomenon such as tremor of the eyelid will not correlate as highly with oral habits as will observational records on such other habit categories as were analyzed in an earlier portion of the study. The last test to be discussed appears on superficial examination to have less in common with nervous habits than the measure of tremor.

TAPPING

Attempts have been made to relate speed of voluntary movement to diagnosed psychotic conditions. Wells found extreme retardation to be significant in psychotic cases with slight evidence of facilitation in the manic as compared to the depressive phase in circular insanity.[10] In view of such studies it appeared worth while to note whether a measure of this function would show significant relationships to oral habits as a criterion. Tapping was chosen as the method for measuring speed of voluntary movement. The first step was to modify the directions used by Hollingworth in individual study for use in group testing with pencil and paper.[11] Each child was supplied with two sheets of paper and a drawing pencil. The directions as modified follow:

Write your name and grade at the top of each sheet of paper. (In the case of first grade children this was done with the assistance of the teacher.) Now put your pencils up like this and do not do anything until I tell you to do so.

This test is to see how fast a child can tap. You must take your pencil and tap on this piece of paper as fast as you can, this way (illustrating). Go all the way across the page and then start a new line. Fix your whole mind on tapping just as fast as you can, till I say "Stop." It is not how hard, but how fast, that counts; so don't tap this way (illustrating pounding) for it only wastes time. I shall

[10]F. L. Wells, "Motor Retardation as a Manic-depressive Symptom," *American Journal of Insanity* (1909), 66:1-52.

[11]Leta S. Hollingworth, "Tapping Rate of Children Who Test above 135 I.Q." *Journal of Educational Psychology* (1926), 17:505-518.

say, "Ready! Go!," and just as I say "Go" you begin. When I say "Stop," quit tapping and hold your pencil up like this (illustrate). Ready! Go! (10 seconds.) Stop!

Now draw a line across the page just below where you made the dots. Be sure not to spoil any of the dots. Now we are going to do the test over again just like we did before and this time you are to make the dots below the line. This time I am going to let you work longer. Ready! Go! (30 seconds.) Stop! Put the paper you have been working on at the upper right-hand corner of your desk. Take the other sheet of paper. We are going to do the same test again for the last time. Ready! Go! (30 seconds.) Stop!

The preliminary ten-second period was used to be certain that the children understood what was expected of them. The children used their favored hand in all trials since the writer had no interest in securing an index of unidexterity, but desired to secure relative measures of maximum speed by which to differentiate the groups. The reliability of the results under the conditions as given was studied to determine whether it would be possible to secure sufficient reliability by group methods to warrant the use of the technique.

The reliability of the method was studied by correlating the record for the first thirty seconds of tapping with the record for the second thirty seconds and then securing the predicted reliability for the sum or average of the sixty-second period.

TABLE XXXI

RELIABILITY OF TAPPING RECORDS

GROUP	N	*r* 30 SECONDS	*r* (SP. BR.) 60 SECONDS
First Grade	38	.69	.82
Second Grade	38	.88	.93
C. A. 8*	57	.76	.86
C. A. 12	60	.84	.91

*Age 8 means from age 7 years 6 months through age 8 years and 5 months, and age 12 means from 11 years 6 months through twelve years 5 months.

The results are presented in Table XXXI for the first two grades and for ages eight and twelve. The coefficients vary between .82 and .93 and are sufficiently accurate for the purpose. If greater accuracy is desired it can be secured by simply increasing the number of records obtained per child. The coefficients at ages eight and twelve would, of course, become greater for grade groups at these median ages because of the greater variability of such groups.

Both economical and reliable results can be obtained by the group-test technique. The writer's interest here is in an accurate differentiation of the group and not in obtaining accurate absolute values for comparison with established norms arrived at by other methods.

The means and standard deviations of the average number of taps for the two thirty-second periods is given by age and sex in Table XXXII. Obtained sex differences in means and standard deviations seem for the most part attributable to sampling errors. The rate of tapping gradually increases with age. The drop for age twelve is probably due to the selected character of the twelve-year-old children in the study —they were those who were below the seventh grade. With these measurements at hand it became possible to determine whether they bore any relation to the conditions that are responsible for nervous habits.

TABLE XXXII

MEANS AND STANDARD DEVIATIONS OF TAPPING RECORDS BY AGE AND SEX

AGE	BOYS			GIRLS		
	N	Mean	S.D	N	Mean	S.D
12	32	149.5	15.2	29	144.1	26.6
11	38	150.1	12.7	38	150.8	13.4
10	41	143.1	14.4	48	144.1	14.7
9	31	125.9	11.0	28	129.6	14.2
8	26	122.1	18.6	28	121.8	14.3
7	21	105.8	14.3	28	110.2	14.8
6	13	115.5	16.4	10	110.5	20.0

Using oral scores as the criterion of nervous habits, the coefficient of correlation with tapping rate has been calculated by age and sex. The tapping rate was the average of two thirty-second periods. The cases included represent all children of these ages in grades one through six with the exception of those absent when the measures were secured. The tapping tests were given immediately following the observations of oral habits.

For eleven out of fourteen samples a negative relationship exists between speed of tapping and oral scores. (Table XXXIII). In six out of seven age groups such a relationship exists. In general the relationship appears higher at younger ages.

TABLE XXXIII

SUMMARY OF CORRELATIONS BETWEEN ORAL SCORES AND TAPPING RATE

AGE	BOYS		GIRLS		TOTAL	
	N	r	N	r	N	r
6	13	−.05	10	−.39	23	−.23
7	21	−.35	28	−.10	49	−.16
8	26	−.23	28	−.04	54	−.14
9	31	+.14	28	−.24	59	−.01
10	41	−.24	48	−.03	89	−.15
11	38	−.23	38	+.09	76	−.05
12	32	−.03	29	+.16	61	+.06

An examination of the correlation arrays at the various ages reveals that the absence of negative Pearson correlations at upper ages may be in part attributable to curvilinear regressions. The relationship for eighty-six children in the sixth grade gives a Pearson r of but +.06 while eta_{xy} is .43 and eta_{yx} is .47. Both extreme retardation and high speed in tapping seem significant for these data. Does this differentiation at the extremes represent the normal analogue of manic and depressive psychoses? This question would have to be answered with more complete data on persons at upper ages. Certainly at younger ages retardation is more

significant as an indicator of nervous habits than acceleration.

The correlation between rate of tapping and a composite of observations of oral, nasal, hirsutal, aural, ocular, and genital habits was $-.21 \pm .12$ for a third grade group. For the same group, speed of tapping correlated with tremor of the eyelids $.17 \pm .12$; i.e., high tremor was accompanied by retardation in tapping—the correlation has a plus sign because of the method of measuring tremor. These coefficients are not large but they are in accord with the general trend of the evidence.

The writer concludes that the obscure conditions of neural tone which determine the speed of voluntary movement are related to the conditions that give rise to nervous habits. The coefficients are small but there is an agreement among the units of evidence offered. In general, extreme retardation in tapping seems most predictive of a large number of nervous habits with some evidence that both retardation and acceleration are significant at later ages.

SUMMARY

In the present chapter an analysis has been made of a group of measures that were considered to be of significance in the diagnosis of nervous habits or allied disorders of the psychoneurotic type. The relationships have not been particularly significant when interpreted by the Pearson coefficient of correlation. Appreciable relationships of the curvilinear type, however, appear to exist. The general ability factor makes the interpretation of scores on personality tests of the paper-and-pencil type a difficult matter. Under the limitations of the data reported here, it appears that scores at either extreme of such tests are of more diagnostic significance than scores in the vicinity of the mean. Tapping rate and tremor have a small amount of differential value.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

The present study has attempted to develop an observational method for the measurement of nervous habits in children, to determine the genesis and incidence of such habits, and to explore the value of certain psychological tests in terms of the observational criterion.

As a preliminary step in an attack on the problem, an inventory of tics based upon the literature was made. It was felt that this should furnish the objective symptomatology which would permit the development of a method of measurement. After some preliminary experimentation with the inventory it was evident that various groupings should be made for ease and objectivity of observation, and for applicability to the school situation. Groupings of habits were made as follows:

1. Oral (sucking thumb, sucking fingers, biting nails, protruding tongue).
2. Nasal (picking nose, scratching nose, wrinkling nose).
3. Hirsutal (pulling and twisting hair, scratching head).
4. Irritational (scratching body).
5. Manual (picking fingers, writhing hands, clenching fists).
6. Ocular (rubbing eyes, blinking eyelids, winking).
7. Aural (pulling ear, picking ear).
8. Genital (manipulating genitalia, thigh rubbing).
9. Facial (grimacing, twitching muscles).

A method of measuring nervous habits was next devised which yields a quantitative score of determinable reliability for each individual. The unit of measurement may be defined, in general, as one or more specified behavior reactions per stated unit of time. Nervous habits in the oral category were given the most intensive study. The unit of measurement for

this particular group was one or more oral habits per five-minute period. Successive observations were made to secure a differentiation in terms of the amount of the habit for each child in the group on the assumption that a child who shows a given behavior in each of a stated number of successive observations is more fixed in that mode of behavior than a child who gives fewer manifestations or none at all. Oral scores based on twenty observations with this method yield reliability coefficients hovering about .87 for elementary school children. The reliability of the method has been studied in application to various groups of habits and to various populations.

Repeated observations reveal that the measures obtained have some constancy over a period of time. For a group of forty elementary children a coefficient of correlation of .46 (corrected for attenuation) was obtained between the oral scores on one occasion and those obtained one year later. Greater constancy is obtained over shorter intervals.

The validity of a single category as a more general measure of nervous habits is shown by the existence of positive intercorrelations between the various sets of observations. This analysis points to the oral measurements as being most predictive of the total. Oral scores were accordingly used in the study of factors in the genesis and incidence of nervous habits of children.

After the development of a method for measuring nervous habits, it became possible to give a quantitative statement of the relation of nervous manifestations to age, sex, family history, imitation, fatigue, nutritional status, and habit formation. Briefly stated and subject to the limitations of the techniques employed and the populations studied, the following conclusions are indicated with respect to the foregoing factors:

1. There is no relationship between the amount of nervous habits and age.
2. The incidence of nervous habits is significantly greater in girls than in boys.

3. Members of a family will resemble each other more closely with respect to nervous habits than will persons selected at random.
4. Evidence is presented which suggests that association with persons of nervous habits will produce nervous habits.
5. Fatigue during the school day tends to aggravate the manifestations of nervous habits.
6. In general, the underweight child will have more nervous habits than the normal at all ages.
7. Experimentation with the rat indicates that superfluous movements may be developed in response to an irritating stimulus. These movements, which appear analogous to what are often called nervous habits, persist after the disappearance of the irritation.

Some study was made of the relationship of the Woodworth-Mathews Personal Data Sheet, the Pressey X-O test, association test, tremor tests, and tapping tests to the observational measures of oral habits. The general intelligence factor makes the interpretation of scores on personality tests of the paper-and-pencil type a difficult matter. The relationship of scores on such tests to the oral records have not been significant when interpreted by the Pearson coefficient of correlation. Appreciable relationships of the curvilinear type, however, appear to exist and are apparently accounted for in part by the tendency to what has been called the "intellectualization of response" on the part of children when giving a subjective report. The tremor and tapping scores show small but consistent relationships to the oral criterion for the groups studied.

The data obtained in the present study indicate that the amount of nervous habits in a given population takes the form of a continuous distribution. The evidence suggests that the problem of nervous habits is the problem of every child just as are such matters as weight, height, and educational achievement. A study of this kind does not concern, therefore, only the occasional individual—the individual who

is different, unusual, or odd. The study directs attention to the normality of the habits studied. Too often the attention of teachers and parents is directed to these habits as abnormal phenomena in the absence of quantitative statement in terms of the general population. The associations between the measures of nervous habits and other factors in the child and his environment suggest possibilities for amelioration although such applications are beyond the scope of this study. The relationships reported, even when consistent, have often been low. It should be borne in mind that the relationships analyzed are only a few of many that exist and any particular phenomenon is a matter of multiple causation. The relationships thus tend to give evidence for lawful trends for groups and not reliable individual predictions.

The inventory of nervous habits obtained by the survey of the literature has uses outside of those made of it in the present investigation. At the present time it is being used in further study as a basis for ratings by teachers and self-ratings by pupils. The rating results offer an opportunity for the study of validity of report as checked against the direct observational measures.

It is believed that the method of measurement developed in the study has possibilities in directions other than that explored in the present report. The unit of measurement—one trait action per stated unit of time—is applicable to the measurement of any observable trait. The length of each observation and the number of repeated observations necessary will vary with the behavior to be measured, the frequency of its occurrence, and the reliability of measurement. Certain traits of personality that have been resistant to measurement through the usual test methods may yield to this natural history approach. After the observational measure has been developed, a more acceptable criterion may be available for the validations of tests than is usually the case. Certain studies already in progress involving variations of the general technique have shown promising results.

APPENDIX

DIAGNOSIS OF THUMB SUCKING FROM THE DENTAL PATHOLOGY

Persistent thumb or finger sucking may produce certain changes in the teeth and jaws. When the thumb is inserted in the mouth the normal pressure equilibrium of the tongue and cheeks is disturbed. The open mouth causes additional pressure from the musculature of the cheeks, which may operate to narrow the dental arch. Further, the thumb acts as a lever, which carries the lower teeth inward and upper teeth outward. This results in what is called an overbite by dentists. Idiosyncrasies of growth may result from variations in the method and point of application of the pressure. These changes offer some possibilities for the diagnosis of oral habits from a dental examination.

After the oral records had been collected for the children in the Institute of Child Welfare, the writer examined the records for the dental examinations. A diagnosis of thumb sucking had been made for six children by the dentist on the basis of a direct examination of the mouth. The oral scores for these children show that five out of six are above the median of the entire group.

Inquiry revealed that the sixth child had been a persistent thumb sucker but had been broken of the habit. The dental anomaly might remain for some time in such a case and an observational method would yield a low score.

At the time the writer's study was in progress, Dr. Joseph T. Cohen of the College of Dentistry was engaged in a study of the development of the teeth and jaws for the same children. His measurements were to be obtained from a series of plaster casts of both jaws. Dr. Cohen and the writer discussed the general problem and agreed to see to what extent a rating of the casts would agree with the functional records. The casts were made and examined by Dr. Cohen for evidence of dental anomalies that might be indicative of thumb and finger sucking.

Seventeen of twenty-nine casts were judged to be normal. The twelve casts remaining were rated by Dr. Cohen without information concerning the oral records collected by the writer. The extent of the overbite was the chief criterion in determining the severity of the habit. The writer then studied the data from the two sources.

In interpreting the results it must be remembered that the rating of the casts is subjective and that other factors than oral habits may influence the shape of the teeth and jaws. Further, the oral records include a variety of habits some of which have little effect on the dental anatomy. The changes in the position of the teeth may also persist after the habit has disappeared.

In view of the possible variables it is of interest to note that a correlation (Spearman rank difference) of .57 exists between the twelve ratings and the observational records. The clearest cases of agreement are found at the extremes.

The writer further attempted to measure overbite from the casts with the use of the screw micrometer. The distance between the most extreme projection of the teeth in the upper jaw and the corresponding measure in the lower jaw was calculated. That this value is one of the criteria used by the dentist in his diagnosis is indicated by the rank order correlation of .63 with his rating of the twelve cases. The correlation between the micrometer measurements and the oral scores for the twenty-nine cases for which both records were available is but .14. The following values are suggestive:

	Boys		Girls	
	N	Mean Overbite in mm.	N	Mean Overbite in mm.
High oral scores	7	2.78	8	3.24
Low oral scores	7	1.96	7	3.13

It should be noted that a better technique for measuring oral habits for this analysis would be to restrict the observations to thumb sucking. Other criteria should also be used in the measurement of the dental anomalies. The data thus

far secured are too meager for extensive generalization. It seems possible that an objective measure of overbite may be of slight value as one element in the diagnosis of oral habits. The evidence also suggests that oral habits are undesirable from the standpoint of the effect on the teeth and jaws.

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